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TOOTH EXTRACTION IN HEMOPHILIA*

By CARROLL LA FLEUR BIRCH, B.S., M.S., M.D., and FREDERICK F. SNIDER, D.D.S., Chicago, Ill.

WHEN bleeding from the mouth is a presenting symptom, the patient commonly seeks first the counsel of his dentist. Hemorrhage alone should forewarn the dentist to investigate the cause before any surgical procedure is instituted. The exciting factors are many: purpura hemorrhagica, scurvy, acute leukemia, hemophilia and others. Serious or even fatal blood loss often follows tooth extraction in hemorrhagic conditions. Hemophilia offers a double hazard; for, during a quiescent period, with no oral bleeding, the drawing of a tooth or the lancing of a gum may result in a tragedy.

Hemophilia was first mentioned in the Talmud[1] in the second century. Here, under dispensation from circumcision, is a careful description of the sex-linked, hereditary character of the transmission of this disease. The first medical article was written by J. C. Otto,[2] of Philadelphia, in 1803, under the title "An Account of an Hemorrhagic Disposition Existing in Certain Families." Since then, hundreds of articles have been published on this subject.

In 1813, Hay[3] reported the case of the famous Appleton-Swain family of Ipswich, Mass. It was in 1820 that Nassé[5] formulated the law of transmission of hemophilia that bears his name. Schönlein,[6] in 1839, first gave to "bleeder's disease" the name hemophilia. In 1855, Ludwig Grandidier[7] published the monograph "Die Haemophilia," containing his widely quoted statistics. Wickham Legg's[8] learned treatise was published in London in 1872. In 1893, A. E. Wright[10] brought out the fact that the clotting time of hemophilic blood was prolonged. About the same time (1890-1894), Franz König[11] published his classical description of hemophilic joints. In 1911, William Bulloch and Paul Fildes[12] published a monograph covering all the known work up to that time and listing 911 references. In 1930, there appeared Schloessman's work[13] with ten pages of bibliography.

*The dental work was done by F. F. S. in his private office; the clinical investigations were made by C. L. B. at the University of Illinois College of Medicine, Departments of Medicine and Orthopedics.

These references represent only the highlights in the history of hemophilia, there being many other valuable contributions.

Clinically, hemophilia is characterized by excessive hemorrhage, which may be spontaneous or may follow injury. The hemorrhage is immoderate and out of all proportion to the extent of the injury. The bleeding may occur from any place in the body, under the skin, into the muscles, from the nose, mouth, stomach or intestines. A very common location is the joints, the hemophilic hemarthroses so characteristic of the disease resulting. After many hemorrhages have occurred in a single joint, permanent damage is done and the patient becomes crippled. Few true hemophiliacs reach adult life, and those who do are almost always deformed by joint hemorrhages. Kidney hemorrhages occur often. Less frequently, there are hemorrhages into the eye, causing blindness; into the middle ear, causing deafness, and into the brain and spinal cord, resulting in paralysis and disturbance of peripheral sensation. Subcutaneous and intramuscular hemorrhages in dangerous areas such as the head and neck may assume serious proportions; e.g., inability to swallow and difficulty in respiration. Peripheral bleeding from superficial cuts usually takes the form of a capillary ooze, which continues relentlessly for hours, days or weeks, and is the cause in 22 per cent of hemophilic deaths.

This disease is definitely hereditary and is sex linked in its transmission. It occurs only in males and is transmitted directly solely by the female. Although the female transmits the disease, she is symptom free. All of the daughters of a hemophiliac become transmitters, passing the disease to 50 per cent of their sons; while 50 per cent of their daughters become transmitters. The disease is never passed from father to son and is never transmitted through the unaffected male. Therefore the only persons in a hemophilic family who may marry and have offspring without the danger of passing the disease to succeeding generations are the symptom-free males.

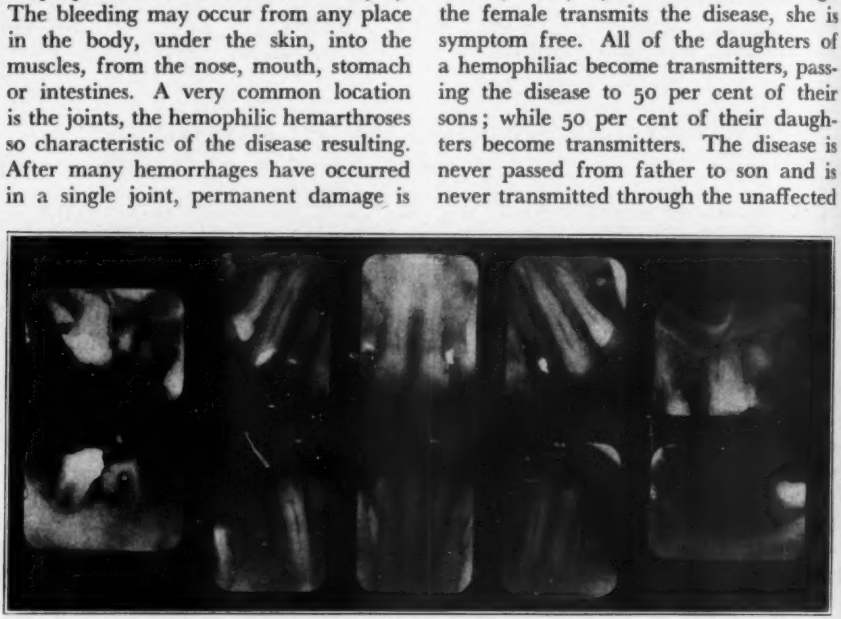

Fig. 1.—Teeth of C. L. before work was begun; showing decaying stumps and cavities.

There is but one blood finding characteristic of hemophilia, the prolongation of the coagulation time. When this test is performed by the test-tube method, normal blood clots in from five to twenty minutes, while hemophilic blood requires an hour, five hours, ten, twenty or even thirty hours, the time depending on the severity of the disease. Cytologically, the blood is normal and shows the same re-

sponse to hemorrhage as the normal. Hemophilia exists in all degrees of severity from the very mild, in which bleeding occurs only after injury, to the most severe, characterized by repeated spontaneous hemorrhage.

More than 100 hemophiliacs were studied and their family histories investigated by one of us (C. L. B.)[14] Ninety-five per cent had hemorrhages from the mouth, teeth, gums and tongue. The remaining 5 per cent was comprised chiefly of very young children. Bleeding at the eruption and loss of the deciduous teeth is almost universal in hemophilia. Many times, the hemorrhage reaches serious proportions. In nineteen of the patients, and two bled generally from the mouth. Internal hemorrhage caused death in twenty-one patients. It is plain that the dentist is intimately concerned with this group of patients.

The history of hemorrhage following tooth extraction is old and interesting. Guerini,[15] in his "History of Dentistry," states that Herophilus and Heracides of Tarentum, in the third century, tell of death following extraction. After the publication of Otto's work[2] in 1803, the number of reported cases of fatal hemorrhage greatly increased. One of the earliest is reported from Leipsic in 1805, probably by Kapp,[16] who states that he knew of several patients with hemophilia,

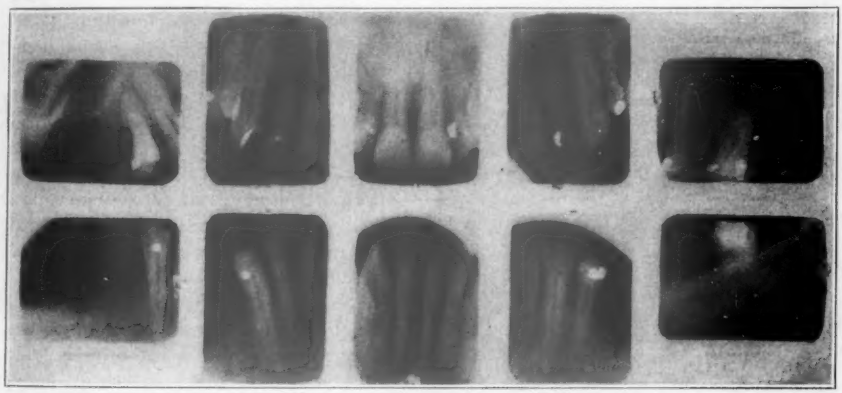

Fig. 2.—Teeth of C. L. after extractions. There are no retained roots and healing is complete.

the first hemorrhage occurred from the mouth.

In the family histories of these patients, there are 113 hemophilic deaths in which the cause of death and the age are known. Fifty-seven per cent of deaths occurred before the fifth year of life. The causes of death are interesting. Twenty-five followed minor surgical procedures, six of which were tooth extraction. One was lancing of the gum. Small accidental cuts were followed by fatal hemorrhage in twenty-three cases. Six persons had a cut lip, two bit the tongue in two of whom bleeding occurred from the mouth in "connection with the fall of the teeth."

An early fatal hemorrhage in a hemophiliac, a man, aged 27, following tooth extraction was reported by Richard Blagden,[17] of London, in 1817. The bleeding was very profuse and resisted all treatment. Finally, the carotid artery on that side was ligated, but the patient bled to death.

R. T. Taynton[18] tells of a fatal hemorrhage following the lancing of the gum of a 6-months-old child. In 1841, W. A.

Roberts[19] extracted a decaying molar in a young man. The ensuing hemorrhage lasted three weeks and finally caused death. J. D. Wolff,[20] in 1844, related an interesting tale of three hemophilic brothers. One died of a hemorrhage in the hip, one from epistaxis and the third from the extraction of a tooth.

A hemorrhage of eighteen weeks' duration, caused by the extraction of a tooth and followed ultimately by recovery, was reported by Uhde,[21] of Berlin, in 1850. A report from Stuttgart by Fischer,[22] in 1855, tells of the drawing of a tooth from a boy, aged 18 years, followed by repeated uncontrollable hemorrhage and death. A. W. Foot[23] reports the cases of two brothers who bled excessively from

Fig. 3.—Teeth of L. P. At the gum margin of the badly decayed upper right lateral incisor, two rubber bands can be seen in place.

tooth extraction. One case was fatal. Schüneman[24] relates the pulling of a tooth in a 21-year-old bleeder which was followed by a hemorrhagic death. Joseph Moreau,[25] of Paris, in 1873 reviewed a large number of instances of excessive bleeding following tooth extraction in hemophilia and other conditions.

Gissles and Wentzel,[26] in 1874, reported an interesting story of three hemophilic brothers. One died after tooth extraction and another bled excessively from the same cause. The third was bleeding from mouth and anus, when he was given a transfusion of lamb's blood, and recovered. From Cincinnati in 1874, Hadlock[27] reports the case of a mulatto boy, aged 7, who died forty-eight hours after tooth extraction. Joaquin, Aquilar and Venegas,[28] in 1878, wrote of a boy of 6 years who bled some after vaccination and excessively after the application of leeches. Later, he fell and knocked out a tooth and bled to death.

In 1878, Hemard,[29] of Paris, wrote of a long series of hemorrhages following tooth extraction. At 16, the patient bled excessively from this cause. When he was 19, the removal of the second upper left molar was followed by such extensive hemorrhage that, on the eighth day, the carotid artery was ligated. Seven days later, the wound in the neck bled violently. The patient recovered. C. R. Francis[30] reports a case of severe hemorrhage caused by the pulling of a tooth. The bleeding was not controlled until the tooth was replaced. The case of Wickham Legg's[9] famous patient whose joints are preserved in St. Bart's Museum was reported in London in 1884. The report tells of a hemorrhage lasting eight weeks after the drawing of a tooth. The patient died from epistaxis.

In San Francisco, in 1895, F. C. Pogue[31] told of an unsuccessful attempt to extract a second upper bicuspid tooth. The tooth broke and the hemorrhage lasted seventeen days. A maternal uncle of the patient had died as the result of a similar operation. Harvey R. Reed[32] reported an interesting case of a hemophiliac, aged 28, in whom, after tooth extraction, hemorrhage was so great that it became necessary to ligate the facial artery. As bleeding continued, the carotid artery was ligated. Hemostasis was finally obtained by the application of a red hot poker. A death occurring on the seventh day after removal of the decayed roots of two molars was reported by Thomas Fillebrown[33] in 1900. Many mechanical and other devices failed to control the flow of blood.

The number of reported cases of exces-

sive hemorrhage from tooth extraction could be multiplied many times. In recent years, since blood transfusion has become safer and is used more frequently, the number of fatal cases has been reduced, but deaths still occur.

Attempts to control the flow of blood after tooth extraction is as old and as interesting as the history of the operation itself.

Wax cloth cones[34] plugged into the sockets were used as early as 1848. Tincture of matico,[35] Monsel's persulfate of iron,[36] nitrate of silver[37] and oil of ergot[38] were all used successfully. Robertson[39] preferred spider web. Elixer of vitriol and tannin,[40] ether,[41] tissue paper,[42] cobweb,[43] tincture of capsicum[44] and *Hamamelis virginica*[45] had their advocates. Norman recommended ice,[46] while Wardle[47] used salt, vinegar and lint. The application of cold and the elevation of an extremity was advocated in 1880.[48] Plantain,[49] potassium permanganate,[50] ragweed,[51] chloroform,[52, 53] spunk,[54] urtica[55] and powdered rice[56] were reported as effective styptics. Wells,[57] in 1887, described a novel preventive of hemorrhage. The tooth was extracted carefully. One-eighth inch was cut from the tip of each root and the tooth was dipped in carbolic acid and glycerin and replaced in the socket. The tooth usually remained about one week and then fell out without hemorrhage.

Kingsbury[58] used plaster of Paris. Franck[59] suspended a rubber dam from the teeth adjacent to the bleeding socket, and applied plaster. Tannic acid,[60] ligated compresses,[61] muriate of cocaine,[62] hot water,[63] hydrogen peroxide,[64] gallic acid,[65] gutta-percha and tannic plugs,[66] cork bandage,[67] modeling compound[68] and puff-ball[69] were advised in succession. In 1895, Younger[70] invented an apparatus to generate steam for use as a styptic.

During the twentieth century, the list of methods of controlling hemorrhage has grown, new ones being introduced, old ones praised and condemned. Turner[71] used sulfuric acid successfully. Power[72] devised a mechanical appliance to hold a compress securely. In 1904, Belden[73] reviewed the literature and compared the merits of modeling compound, calcium chloride, gelatin, adrenalin, turpentine, *Veratrum viride* and powdered charcoal. He quotes Ochsner: "When four or six whites of eggs are given three times daily, there seems to be a very definite effect exerted on the clotting properties of the blood."

Fauconnier[74] advised the injection of Nolf's propeptone; while Leavitt,[75] who states that his Wassermann reaction is negative, saturated sterile cotton with his own blood and applied it to the bleeding surface, with cessation of bleeding. Normal[76] used a splint or hemorrhage arrester. Horse serum was used by Shore[77] and Park.[78] Bagchi[79] advocated diphtheria antitoxin. Steadman[80] reviewed the use of turpentine. Locher[81] and Friedman[82] used varied treatment. Balyeat[83] reported a fatal case after many methods of treatment had been tried. Pickering[84] used liver extract; Flint,[85] a mechanical device. Zona[86] advocates the muscle substance of the dove and transfusion.

This is by no means a complete review of the literature, but it gives an idea of the variety of methods employed in an attempt to control hemorrhage following tooth extraction, especially in hemophilia.

Since we began our study of hemophilia in 1926, the care of the teeth has been one of our gravest concerns. Dr. Dalitsch[87,88] did the dental work on the early members of this group of patients without one serious hemorrhage; nor was it necessary to resort to transfusion in any case. Also, it was he who directed our attention to the use of rubber bands in the extraction of teeth.

EXTRACTION BY USE OF RUBBER BANDS

Perhaps extraction of the teeth by use of rubber bands was first suggested by an

accident reported in 1870.[89] Dr. Wentworth told of a rubber band which, through error, had been left about a tooth and "gradually worked its way to the apex of the root, dissecting away the membranes of the root and loosening its connection with the alveolus." A sketch of the tooth with the attached band accompanied the article. McQuillen had a similar experience with a wisdom tooth. He also saw a little girl of 11 whose two incisors became sore and loose during the process of being straightened. The teeth were explored for some distance above the neck, and rubber bands were found and removed.

Merson[90] warns against the abuse of the dam. Weiss[91] tells the following "Misadventure with the Dam": There was accidental detachment from the main sheet of the rubber dam of a ring of rubber about a tooth, and, one week later, there was a little tenderness. Cursory examination did not disclose the trouble. In three weeks, the tooth was very tender and loose and had to be extracted. The rubber had worked its way up to the root just as an elastic band would, denuding the root of its periosteum as it went.

In 1925, Rowe[92] published a warning of the danger in the use of the rubber dam. Cambrook (1933)[93] told of a hemophilic patient who, at the time he came to him, had sixteen teeth in the mouth. "The missing teeth had not been extracted, but a rubber regulation band has been placed around each tooth at the gum margin. This set up peridental trouble and in course of time the teeth had fallen out. Painful but effective." Cambrook preferred to use adrenalin, blood transfusion and cotton wool packs.

Dalitsch,[87] in 1934, wrote:

> One of our patients had several teeth removed by the use of an elastic band applied to the neck of the tooth. This constriction caused a slow separation of the periodontal membrane and the tooth eventually loosened and fell out. Irritation and soreness were not great and no excessive bleeding occurred. Evidently, the pressure from the band resulted in anemic atrophy of the periodontal tissues.

If a tooth of a hemophiliac is extracted by the usual procedure, he presents a pathetic sight. The mouth is filled with blood clots and thin streaks of blood mixed with saliva drool from the parted lips. The tongue is frequently so swollen by hemorrhage that it cannot be retained within the buccal cavity, but protrudes as a foul, blackened mass, which soon becomes dry and cracked. Swelling and discoloration include the floor of the mouth and extend into the throat and neck. The soft tissues under the chin become a veritable bag of blood. In the early stages, part of the blood is swallowed and then vomited. Later, as the pressure in the neck increases, swallowing becomes impossible and breathing difficult. There is a steady drooling of blood from the mouth. The odor is most offensive, being similar to that of lung abscess. The temperature frequently reaches 104° F. Under these circumstances, treatment is very difficult. Local pressure only tends to increase the subcutaneous and intramuscular hemorrhage. Subcutaneous treatment cannot be given because of the resultant hemorrhage. Rectal feeding is unsatisfactory and may cause anal bleeding. The passage of a nasal tube is of course contraindicated. Intravenous fluids, except whole fresh blood, cause an elevation of blood pressure and dilute the coagulating elements and may cause an extension of the hemorrhage. Local measures are not often satisfactory. Indeed, curetting and lancing, resorted to in the hope of relieving pressure, all too frequently result in fatal hemorrhage. The ligation of the facial and carotid arteries has been unsuccessful in most instances. Whole fresh blood transfusion early in the hemorrhagic period gives the greatest promise. Blood from a blood bank is of little help as the coagulating substances needed in

hemophilia deteriorate rapidly after the blood is drawn.

After a trial of many methods of controlling hemophilic hemorrhage from tooth extraction, including systemic medication, the use of mechanical devices and topical application of many styptics, the use of the elastic band seemed to offer the least danger. Many of our patients were in sorry need of dental care. At first, the ordinary orthodontic rubber ligatures were used. In many instances, these proved to be too thick and heavy; for where the teeth were close together, there was a tendency to strip the adjacent tooth. Very small rubber tubing, size one-eighth inch, wall one-thirty-second inch, was cut into tiny fine bands. These seemed to retain their elasticity longer than the orthodontic bands. A third type of band was tried, one that was circular in cross-section. This was found to dissect too rapidly and was apt to produce a little bleeding. Several bands were frequently used on a single tooth, placed in succession, at intervals of several days.

The mechanics of the slow extraction method is simple, functioning on the principle of the inclined plane. When the band is placed on the tooth above its greatest diameter, owing to its elasticity, it tends to move toward the area of lesser diameter, the root. As the band moves up, the tooth moves out, and the blood vessels become stretched. With the increase in tension, the caliber of the blood vessels becomes smaller, until the intimal walls approximate and the lumen is obliterated. A tissue reaction is also set up in the gum in response to the presence of the foreign body. The net result is a complete and clean denudation of the root, with its complete expulsion in from four to 109 days, usually without the loss of a single drop of blood. If the tooth has a full crown, it is necessary to remove it, at least in part; for as the tooth is ejected from the gum, it will protrude beyond the bite line, interfering with eating and causing considerable pain. In teeth with multiple divergent roots, it is sometimes necessary to split the crown and extract each root separately, encircling each with an elastic band.

REPORT OF CASES

The case of C. L. is classical. There was bleeding from the umbilical cord for five days after birth. Hemarthrosis of practically every joint has occurred. The patient was on crutches six years because of one knee hemorrhage. There is permanent deformity of both elbows, one knee and one hip. One leg is 1½ inches shorter than the other because repeated hemorrhage into the hip joint has destroyed the head of the femur. Gastrointestinal and kidney hemorrhages have occurred a number of times. Coagulation time varies from one to ten hours. The disease is hereditary. A maternal uncle bled to death at the age of 31 years, after extraction of a tooth.

Work was begun in August 1937. The teeth and gums were in a bad condition. (Fig. 1.) Several crowns were completely decayed to the gum line, so that each root could be treated separately. A band was placed on the mesiobuccal root of the upper right first molar. There was no bleeding and no soreness. The root dropped out spontaneously in four days. On the distobuccal root of the same tooth, a band was placed and remained for twenty-three days. It was then removed and a fresh band applied. Seven days later, the root was out, with no bleeding and no soreness. Then came the last root, the distolingual, which was expelled in four days with no discomfort. The socket healed quickly and well.

As there was a heaping up of the gum about the lower left first bicuspid, a cement cap was packed down, to force the gum away. This was left for eighteen days and was replaced by an oxyeugenol pack, which was left in for seven days. The rubber bands were too large to get into the gingival crevice, but it was possible to encircle the root with No. 50 white sewing thread. Thirteen days later, an elastic band was applied, and evulsion of the tooth occurred fifteen days later. The total time required was fifty-

three days. There was no bleeding and very little discomfort.

The lower right first molar required four bands and fifty-seven days' time; while the lower right first bicuspid was out in six days and required but one band. The conical shape of the lower left second bicuspid caused the rubber band to work its way rapidly toward the apex, producing some soreness and a little bleeding. A soft tissue flap covered the root of the upper right second bicuspid. After being tied at its root with a rubber ligature, the flap severed in four days without bleeding. Packs of guttapercha and oxyeugenol were used to force the soft tissue from the partly submerged root. After seventy-four days, it was possible to put a band on the root. A second band was placed twenty-eight days later, and a third after eight additional days. The root was ejected spontaneously thirty-eight days after the first band was applied.

The root of the upper left second bicuspid was almost completely submerged by hypertrophied gum and required packs to shrink the soft tissues sufficiently to expose the margins of the root. After the use of packs for thirty-eight days, dental floss was tied about the root. Four days later, a rubber band was placed and in two days the root was out. There was no bleeding. A large amalgam filling comprised most of the crown of the lower right second molar. This was removed and a band applied. As the tooth was pushed from its socket, it struck the opposing molar; which interfered with the bite. The tooth became quite sensitive, but was out in eighteen days without hemorrhage. The socket closed quickly and was completely healed in three days. Had the crown been ground down before the band was placed, the discomfort would have been avoided.

For the upper left third molar, three bands were used, and the tooth was out in thirty-eight days; with no bleeding. The upper right third molar required one band, and was out in three days; with no bleeding. The lower right third molar required one band, and was out in four days; with slight oozing. The patient was in a bleeding phase at this time and had a spontaneous hemorrhage in his elbow. The upper right second molar was a large tooth and was difficult to remove. Eighteen bands were used. The tooth came out spontaneously in seventy-six days without bleeding, but there was considerable soreness. The remaining portion of the crown of the upper left second molar was removed, six bands being used. There was considerable soreness, for the bands caused the tooth to rotate. The process was accompanied by a slight oozing of blood for a few days. All symptoms disappeared after the ninth day and the evulsion of the tooth was uneventful, the thirty-fourth day.

This completed the work. Thirteen extractions had been accomplished. Roentgenograms showed that no roots were retained and that healing was complete. (Fig. 2.) Vulcanite partial dentures have given excellent results since December 21, 1938.

B. C. is 19 years old. His is a severe case of hemophilia which has presented classical symptoms since birth. The coagulation time averages about ten hours. The teeth and gums were in bad condition. There were

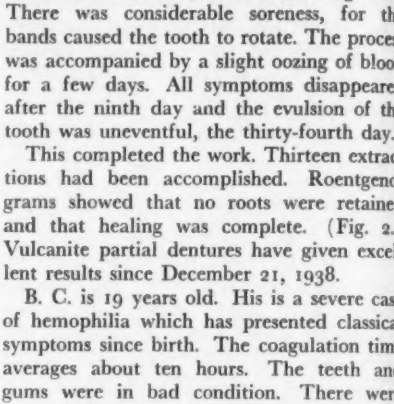

Fig. 4.—Teeth of L. P. after restoration.

deep cavities, alveolar abscesses and partially submerged root snags. Work was begun in April 1938. The story is similar to that of C. L. Six roots have been removed. Twice, the patient became impatient when the tooth was loose and annoying and pulled the root out with his fingers. Both times there was moderate bleeding, once for two days and the other time for six days. Both stopped spontaneously and caused no real difficulty.

L. P., aged 34, has suffered from hemophilia in a rather severe form since birth. Hemorrhages have occurred in practically all joints, causing permanent deformity of knees and elbows. Epistaxis has been frequent, while hematuria, though rare, has been alarming. In 1923 a tooth was extracted by the ordinary procedure, and the ensuing hemorrhage was so grave that hospitalization

and three transfusions were necessary to control it. The disease has been known in the family for four generations. The coagulation time is from two to five hours.

The patient was in desperate need of dental care. There were many large cavities and retained decayed roots, with soft hypertrophied gums and markedly decalcified front teeth. Work was begun November 17, 1938. The lower left second bicuspid required thirteen rubber bands and forty-four days for extraction. There was little discomfort, no bleeding and perfect healing. The distal root of the upper left first molar required four bands and was extruded spontaneously without discomfort in thirty-six days. Figure 3 shows the upper right lateral incisor to be badly decayed and broken down. The root was vital and gave more annoyance than any of the teeth so far. Dental floss was the first ligature used. This was followed by rubber bands in succession until eight were employed. Some pus was discharged from the socket and it required 109 days for the evulsion, after which the socket healed readily. The mesial root of the upper left first molar required three bands and nineteen days. Now there are three bands around the upper right third molar.

Three-quarter crowns have been placed on the lower central incisors; which seemingly has arrested destruction. The crowns have been on for four months. A porcelain jacket crown was placed on the discolored carious upper right central incisor. The space of the late upper right lateral incisor is filled by a bridge, with a three-quarter crown on the cuspid and a rest behind the jacket. (Fig. 4.) It was possible to save some of his teeth by the use of large inlays.

The cosmetic effect is remarkable, but is exceeded by the psychologic response, for the patient had long since given up hope of dental restoration.

Work has been begun on several other patients, but has not progressed sufficiently to warrant reporting. To date, twenty-six extractions have been successfully completed by this technic without any serious untoward symptoms. The procedure, though long and tedious, seems justified when the results are compared with the usual fulminating hemorrhage following ordinary tooth extraction in hemophilia.

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THE PATHOLOGY OF DENTAL CEMENTUM

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CEMENTUM that is formed during the development and eruptive adjustment of the tooth is spoken of as primary cementum. Like dentin, cementum may continue to form, and a certain amount of apposition occurs throughout the existence of the tooth, as a physiologic process. However, abnormal formation of cementum is very common, and cementum thus formed is spoken of as secondary cementum. The process producing it is known as hypercementosis, which may be defined as a secondary deposit of cementum on a root of a tooth that has taken on proportions beyond the normal limit. Many textbooks have the point of view that hypercementosis is due to traumatogenic stress or a low-grade irritation caused by infection, the theory having been accepted by the profession at large. Hypercementosis, however, is observed in teeth that are in normal occlusion as well as in teeth that are unerupted. It is also found if antagonists are missing in normal teeth that have no occlusion. Further investigation of the problem of hypercementosis therefore seemed indicated.

NORMAL CEMENTUM

It may be profitable to review first our knowledge of the normal structure and function of cementum at the root of a tooth. Cementum is the product of the pericemental layer of the peridental membrane. It is the softest of the three hard tissues of a tooth, resembling bone in structure. In man, only the root of the tooth is covered with cementum. The portion covering the cervical section of the root, which is called lamellar cementum, is free from enclosed cells. Lamellar cementum consists of fine fibers within an irregularly calcified homogeneous matrix, which are collected in bundles that run vertically to the surface of the root. In cross-section, these bundles appear polygonal. In the apical region and in the bifurcation of the roots, we find osteocementum which contains enclosed cells. It is similar to bone in structure, and, as in bone, the cement cells lie in lacunae contained in the matrix. These cells, which are derived from the peridental membrane, are cementoblasts, and they become embedded while the cementum is being laid down. The lacunae are connected with each other by fine canaliculi containing protoplasmic processes of the cells. The lacunae and canaliculi of the cementum are larger and more irregular than those of bone. The canaliculi communicate freely among themselves as well as with the peridental membrane.

Osteocementum, like lamellar cementum, is deposited in layers parallel to the surface, as is indicated by the presence of incremental lines. In their superficial layers, both types of cementum are penetrated by fibers of the peridental membrane (Sharpey's fibers). These fibers attach the cementum to the peridental membrane, and this in turn to the bone. Thus, the function of the cementum is the retention of the tooth. Cementum,

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however, has another function: it repairs damages that are inflicted on the tooth. This is accomplished by means of cells of the pericemental layer of the peridental membrane, which produce the cementum that is laid down in an effort at repair.

Part I
SECONDARY CEMENTUM

Secondary cementum may be laid down in a variety of ways. Four distinct processes can be distinguished:

Fig. 1.—Photomicrograph of upper first molar sectioned through two buccal roots. Cementum completely surrounds the roots and is seen in the bifurcation. This tooth had no antagonist. The area of hypercementosis is composed of osteocementum. C, cementum. B, bone. M, marrow. D, dentin. P, pulp chamber.

1. General hypercementosis due to elevation of the tooth.
2. Hypercementosis due to infection.
3. Spike formation.
4. Tooth repair.

1. *General Hypercementosis.*—Many

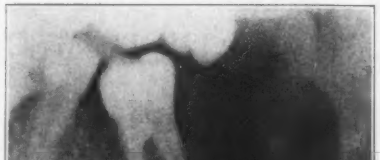

Fig. 2.—Roentgenogram of dentigerous cyst with crown of involved tooth embedded in a cystic area. Hypercementosis is not apparent.

Fig. 3.—Photomicrograph of tooth shown in Figure 2. Hypercementosis affects the bifurcation and the apices of the tooth. Since this tooth was embedded in the jaw and was not in occlusion, malfunction cannot have been the cause of this condition. D, dentin. OD, odontoblastic layer. P, pulp. C, cementum.

layers of cementum are deposited, being arranged concentrically around the root

of the tooth, layer upon layer as shown in Figure 1. Sometimes, the whole root is covered; in other cases, the cementum is deposited only at the apex of the tooth. Hypercementosis not only affects erupted teeth, but also occurs on embedded unerupted teeth and retained fragments of a root. It cannot be attributed to function of the tooth since it is seen in teeth without antagonists. Such teeth continue to erupt; which tends to reduce the size of the attached part of the root and increases the width of the peridental membrane. Nature attempts to counteract this tendency by laying down cementum to maintain the length of the root and procure a firm attachment for the tooth.

Gottlieb (1938) has demonstrated that teeth erupt continually throughout life. As this eruption goes on gradually, all teeth show a slight increase in the thickness of the cementum at the apex of the roots. This increase, however, cannot be called hypercementosis, unless the deposit is accelerated by a greater speed of eruption of the tooth. This is seen in teeth without antagonists and in

Fig. 4.—Photomicrograph of lower bicuspid with no antagonist and which has become elevated beyond occlusal plane. The microscopic examination disclosed that, at one time, this tooth received abnormal occlusal trauma, as the root had undergone resorption at a previous time. The resulting defect, however, has repaired itself. The photomicrograph also shows that since the antagonist has been lost, bone has been built up in the periapical region (bundle bone), and additional cementum has been laid down to offset the distance of elongation of the tooth. D, dentin. C, cementum. P, pulp. B, bone. M, marrow. RC, repair cementum.

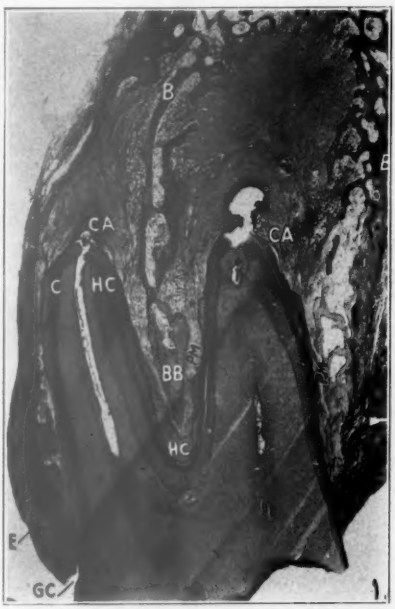

Fig. 5.—Photomicrograph of buccolingual section of upper first premolar. Cystic areas are seen in the periapical region on both buccal and lingual roots. The tooth shows marked hypercementosis along the roots and in the bifurcation. The alveolar bone between the roots shows increased lamination (bundle bone), denoting that the tooth is moving occlusally, probably stimulated by cellular activity of the inflammatory changes in the periapical region. The section can be interpreted as showing that hypercementosis takes place owing to increase in the rate of eruption. E, epithelium. GC, gingival crevice. PM, peridental membrane. B, bone. C, cementum. CA, cystic area. BB, bundle bone. HC, hypercementosis.

embedded teeth which have a tendency to move in an effort to erupt. However, in impeded teeth, where no movement is possible, no cementum is in evidence except that which was laid down previously, while the tooth was able to move.

Many teeth which have become elevated so as to occlude with the opposing gum are still firm. We obtained many cases at necropsy which, on microscopic examination, showed marked hypercementosis and, in addition, layers of bone (bundle bone) laid down in a horizontal plane, both in the periapical region (Fig. 4) and in the bifurcation of multirooted teeth. (Figs. 5 and 6.) How continuous eruption of the tooth tends to widen the peridental space is shown in Figure 7. The deposit of cementum at the side as well as at the apex of the tooth makes up for this deficiency and is Nature's attempt to maintain the peridental membrane in normal width. This is essential, for if the peridental membrane is widened to any great extent, the tooth will be able to move during mastication. If this occurs, the bone becomes affected as in parodontosis, in which the alveolar process is resorbed, and the peridental membrane becomes wider. Therefore, greater movement is possible; which, in turn, enhances the effect on the bone. Thus a vicious circle is established.

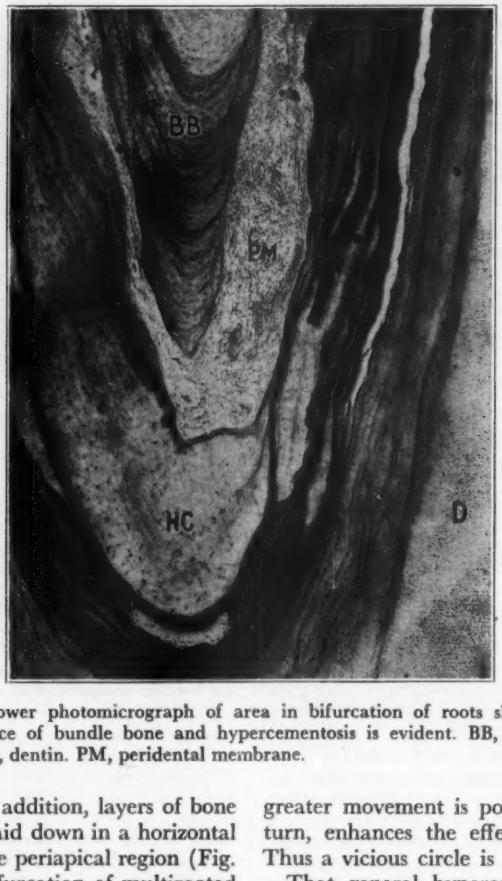

Fig. 6.—High-power photomicrograph of area in bifurcation of roots shown in preceding figure. The presence of bundle bone and hypercementosis is evident. BB, bundle bone. HC, hypercementosis. D, dentin. PM, peridental membrane.

That general hypercementosis is due to occlusal displacement of the teeth is easily illustrated. Roentgenograms show that the teeth in function are normal; whereas those without antagonists are

affected by hypercementosis. It is not always possible to determine by x-ray examination whether hypercementosis is present, since secondary cementum can be visualized only if it develops in great amounts, or if it is localized at the apex or sides of the tooth. Microscopic examination is the only means by which a sure diagnosis can be made.

Cementum also is laid down on the side of the tooth root if movement occurs in a mesial or distal direction. Microscopic examination of necropsy cases demonstrates that, in such movement of a tooth, bone is resorbed on one side and laid down on the other. Cementum, however, is also being laid down by the pericemental layer at the same time as and on the side where bone is deposited

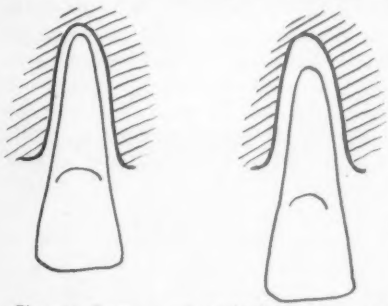

Fig. 7.—Increase of periapical space and width of peridental membrane if tooth is elevated from socket.

by the periosteal layer. This again can be interpreted as Nature's attempt to maintain the normal width of the peridental space.

2. *Hypercementosis Due to Infection.*—The teeth that are involved by chronic inflammation of the supporting structure in the periapical region frequently are affected by marked hypercementosis. It occurs beyond the inflammatory area. Mild irritation is known to cause cellular activity at the periphery of the inflammatory area. Such mild inflammatory irritation may stimulate cemental growth and cause hypercementosis. It is to be noted, however, that, at the site of inflammation, no growth of cementum is seen because the part of the root affected by the inflammatory process has lost its ability to form new cementum, the cementoblasts and cells from which these may re-form having been destroyed.

As regards the cellular activity in the periapical area, however, this tooth is treated as a foreign body, and consequently the tooth erupts faster than normal if it has no antagonist. This process again brings about the formation of

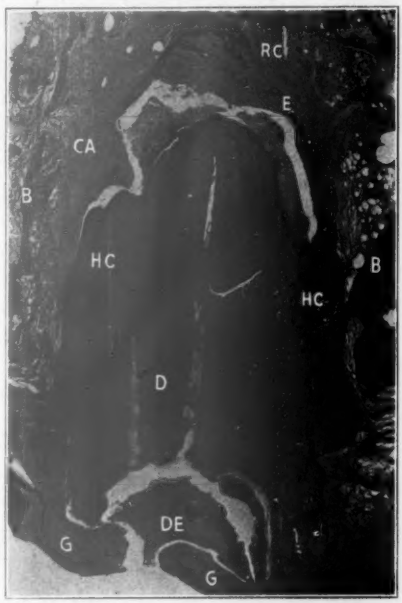

Fig. 8.—Photomicrograph of embedded root at apex of which there is a cyst. The root fragments show hypercementosis at the side, but practically none at the apex. This probably is due to a strong inflammatory reaction which does not allow any proliferation of tissue at the apex. Hypercementosis occurring beyond the apex may be explained by a more mild irritation away from the inflammatory region. However, acceleration of the rate of eruption caused by periapical inflammation may be an important factor. G, gingiva. DE, débris. D, dentin. HC, hypercementosis. E, epithelium. RC, round-cell infiltration. CA, connective tissue capsule. B, bone.

secondary cementum to maintain a normal peridental space and a normal clinical root. Because it cannot form at the apex, for the reason stated, it is laid down only alongside the root. Therefore, hypercementosis in such cases is not due to irritation or to inflammatory stimulation alone, but may be partly due to eruptive hypercementosis if the crown is destroyed so that the tooth can grow out of the socket.

Fig. 9.—Photomicrograph and x-ray film of lingual root of upper first molar showing spike formation at apex. The occlusion, observed at necropsy, showed a marked, heavy bite. Similar spike formation was also found on sectioning the premolar. E, epithelium. P, pocket. GC, gingival crevice. B, bone. PM, peridental membrane. PF, principal fibers. S, spike formation.

3. *Spike Formation.*—Cementum resembling spikes is found on the root surfaces of some teeth. These formations are found on both the apical and the coronal portions of the root. They consist of outgrowths of cementum along the principal fibers of the peridental membrane, and are due to heavy function, as has been demonstrated by Gottlieb in the case of an elderly man who used to carry a heavy pipe hanging on the two lower incisors. So great an overburden as a hanging pipe is not necessary, however, for these cementum spikes to form. They are found in many cases in which the teeth are involved in heavy occlusal function only. It is practically impossible to diagnose spike formation of cementum clinically, nor can we ascertain by x-ray examination whether this type of cementum is present. Necropsy material, however, gave us an opportunity for extensive study. It demonstrated that spike formation, although not common, is seen frequently in cases of hyperfunction. That it is not constantly encountered under such conditions is due to the different reactions to overfunction. Without going into the intricate problem of occlusal trauma, we shall point out that when the stress becomes very great, the principal fibers of the peridental membrane increase in number in order to give a better attachment to the tooth, the principal fibers (Sharpey's fibers) running from cementum to alveolar bone. Later, we may get spike formation, which results from the production of osteocementum in the principal fiber, giving the appearance of a spike.

4. *Tooth Repair.*—Repair of the tooth may be accomplished with either lamellar cementum or osteocementum. At times, both types are present. The cervical portion of the tooth may be repaired by either type; whereas, in the apical portion, osteocementum is more commonly found.

Injury to the cementum of the root due to occlusal trauma is common. It results from an increase of stress on a

tooth causing resorption. This resorption is usually repaired by the activity of the cementoblasts in that vicinity in laying down new cementum upon the original structure. As this reparative cementum is being laid down, new Sharpey's fibers are embedded.

Another injury which is repaired by cementum is fracture of the root of a tooth, due to occlusal trauma or accident. Figure 16 shows a roentgenogram and microscopic section of the mandibular incisors in which all four roots have been fractured at the tips, seemingly from occlusal trauma. The tissue still shows the effects of traumatization. The apical fragments have been surrounded by cementum, as has the end of the root.

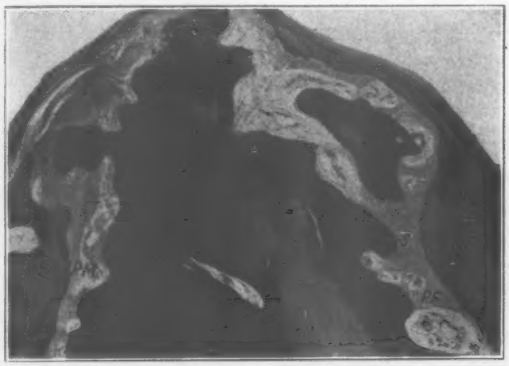

Fig. 10.—High-power photomicrograph of root shown in Figure 9. The spikes are seen growing along the principal fibers. D, dentin. PF, principal fiber. PM, peridental membrane. B, bone. S, spike.

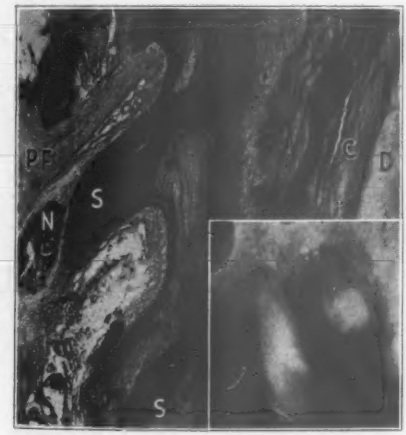

Fig. 11.—X-ray film and photomicrograph of upper cuspid which received abnormal occlusal stress. Microscopic examination revealed spike formation at the apex. This section is the distal portion of the root. As can be seen, the spikes of cementum grow along the principal fibers of the peridental membrane. Necrotic areas in the peridental membrane were caused by occlusal trauma. D, dentin. C, cementum. S, spike formation. PF, principal fibers. N, necrosis.

Another very common injury repaired by cementum is the cemental tear, which is due to acute occlusal trauma such as occurs when a tooth is hit by a blow. The attachment of cementum to peridental membrane is stronger than the union at the dentinocemental junction, and a small area of cementum is likely to peel off when the accident takes place. This defect is repaired by ingrowth of connective tissue of the peridental membrane which forms the matrix, in which calcium salts are laid down. Such repair cementum may entirely fill the defect. If a whole area of cementum is peeled off, the connective tissue may grow in between, cementum being laid down on

the root surface and around the fractured piece, which may remain separated or become attached.

Still another reparative function of cementum is the closing of the foramen in root-canal therapy. In the ideal root canal case, cementum at the apex will grow in so as to close off the foramen completely.

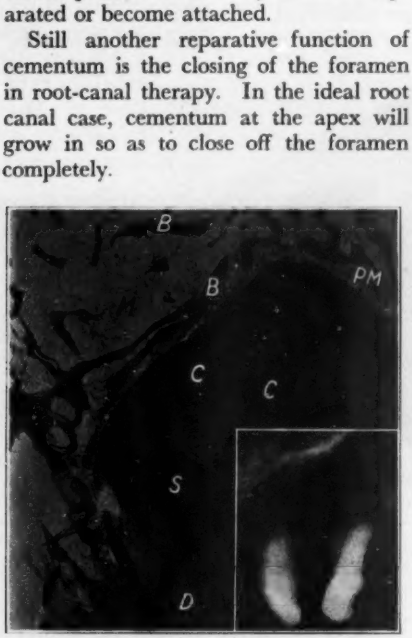

Fig. 12.—X-ray film and photomicrograph of upper cuspid which was affected by marked attrition but at time of necropsy had no antagonist. From the appearance of the attrition, it can be deduced that, at one time, this tooth received an abnormal blow. The photomicrograph reveals a spike of cementum which has been enclosed by a layer of hypercementosis formed around the apex. This section is interpreted as showing two phases of function, the first due to heavy function and resulting in spike formation; the second occurring when the antagonist was lost and the rate of eruption was increased, resulting in a generalized hypercementosis. D, dentin. C, cementum. S, spike formation. B, bone. M, marrow. PM, peridental membrane.

Part II

NEOPLASTIC CEMENTUM

Another type of cementum is due to tumor formation. It is formed by cementoblasts which develop in abnormal locations and, as in all tumors, the differentiation of the tumor cell may vary in individual cases so that the resulting cementum may be diversified in its histologic appearance. We distinguish (1) cementicles and (2) cementoma.

Fig. 13.—Photomicrograph showing resorption area in cementum which has been repaired by osteocementum. D, dentin. CR, cementum resorption, the line to which cementum has been resorbed. CI, osteocementum. PM, peridental membrane. B, bone.

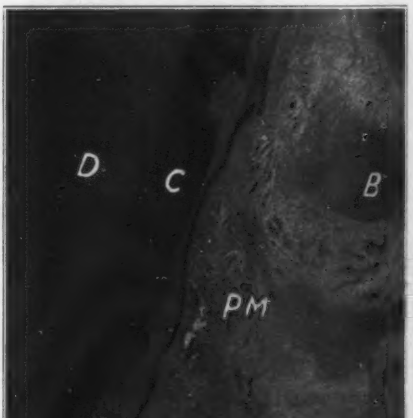

Fig. 14.—Photomicrograph of section along root showing resorption areas that have been repaired by osteocementum. D, dentin. C, cementum. OC, osteocementum. B, bone. PM, peridental membrane.

1. *Cementicles.*—Cementicles are calcified bodies which may be found in the peridental membrane. They generally show a lamellar structure. Burn *et al.* (1937) have demonstrated the formation of cementicles in vitamin A deficiency. Gottlieb (1938) has shown that they form around dead epithelial cells. According to Shimamine (1910), cementoblasts are not absolutely necessary for the formation of cementicles: they may form from connective tissue cells of the peridental membrane. The cementicles, as they grow larger or as the cementum of the root increases in thickness, often unite with the cementum of the root. Such incorporated cementicles stand out from the surface as semiglobular nodules. At times, they are entirely embedded. One of us (K.H.T.) found that cementicles may grow and fuse with one another to form a cementoma.

2. *Cementoma.*—Tumors made up of cementum form in the subapical area, generally away from the teeth. Frequently, a tooth or several teeth are connected with the tumor and give evidence of hypercementosis. Cementomas form after the enamel organ and the dentin papilla have developed, often after the tooth has erupted. The tooth therefore develops normally, the tumors originating from the apical portion of the dental follicle or its end-product, the mature peridental membrane. Cementomas may remain small or may develop to considerable size, when they are apt to expand the bone. They have a tendency

Fig. 15.—X-ray film and photomicrograph of lower central incisor showing two marked cemental tears, one at distal surface and one starting at mesial surface. This tooth received an abnormal blow and the microscopic examination revealed that the tooth was moving distally. Bone can be seen built up on the mesial side, while, on the distal, it is undergoing resorption. Repair of the cemental tears by osteocementum has started. At areas where this repair has taken place, the attachment of new principal fibers is evident. D, dentin. CT, connective tissue. BB, bundle bone. RB, resorption of bone. M, marrow. P, pulp. OC, osteocementum.

to appear as multiple tumors. The formation of cementoma has been described in three stages (Thoma, 1937): (1) fibromatous stage, (2) cementicle-forming stage and (3) mature cementoma. In the fibromatous stage, the tumor consists entirely of soft tissue and may be mistaken in x-ray examination for an area of periapical infection, because the tumor produces an osteolytic defect. In the cementicle-forming stage, small calcified structures are formed which at first can hardly be identified in an x-ray picture. They may grow by concentric additions and therefore appear as laminated structures; or they may have a

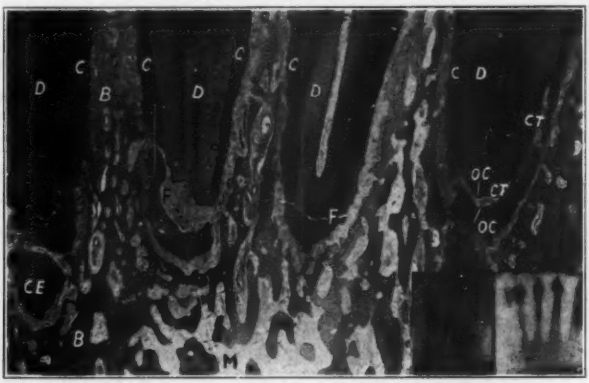

Fig. 16.—X-ray film and photomicrograph of apical and periapical region of four lower incisors which were affected by abnormal occlusal trauma. The central incisors show fracture of the roots. The lower right lateral incisor presents a cementoma which in none of the serial sections is found attached to the root. In the lower left lateral incisor, a cemental tear peeling off the apical portion of the root is shown. Repair of this cemental tear has started. Connective tissue from the peridental membrane has invaded the tear, and osteocementum is being laid down at both sides of the dentin and cementum. Resorption of the alveolar bone is going on with great rapidity owing to excessive trauma. D, dentin. F, fracture. CT, cemental tear. CE, cementoma. B, bone. M, marrow. R, round-cell infiltration. OC, osteocementum. C, cementum.

Fig. 17.—X-ray film and photomicrograph of lower second molar showing cystic area on mesial root. The distal root is attached to the bone. The junction of the hypercementosed root to the alveolar bone forms a true ankylosis. B, bone. E, epithelium. C, cyst. A, ankylosis. HC, hypercementosis.

homogeneous appearance. Later they fuse, producing in the x-ray a radioparent mass. In other cases, the cementum is laid down as trabeculae of osteocementum, which often resembles bone and makes a differential diagnosis difficult. The mature cementoma is surrounded by a connective tissue capsule, the remainder of the tissue from which it is formed. The spaces between the cementicles or the trabeculae are also filled with fibrous connective tissue, in which new cementicles may be formed.

SUMMARY

1. Secondary cementum may be formed by four different processes: (a) general hypercementosis due to elevation of the tooth; (b) hypercementosis due to inflammatory reaction; (c) spike formation, and (d) root repair.

2. General hypercementosis is due to the increased rate of eruption of teeth and Nature's attempt to maintain the normal length of the root and the normal width of the peridental membrane.

3. General hypercementosis is not dependent on function.

4. Normal function of a tooth does not require the additional laying down of cementum.

5. Spike formation may occur in occlusal trauma.

6. In apical infections, secondary cementum forms partly as a result of cell irritation from the inflammatory conditions. However, if the crown is destroyed, or if the tooth has no antagonist, the tendency of the inflammation to cause the tooth to erupt faster is an important factor in the formation of localized deposits on the side of the root.

7. In resorption on the surface of the roots, injury such as a cemental tear and root fracture, repair is made by means of secondary cementum.

8. Neoplastic formations can be divided into (a) cementicles and (b) cementomas.

9. Cementicles are formed in the peridental membrane and may become attached to the cementum of the tooth.

10. Cementomas, which generally form in the subapical area, vary in histologic makeup according to the degree of specialization of the tumor cells. Thus, it may be composed of homogeneous or laminated cementicles or trabeculae of osteocementum resembling bone.

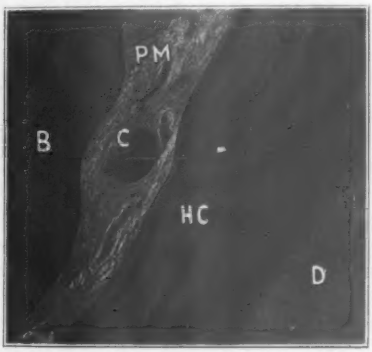

Fig. 18.—Photomicrograph of section of peridental membrane showing cementicle formation. B, bone. PM, peridental membrane. C, cementicle. HC, hypercementosis. D, dentin.

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PROBLEMS IN PLASTIC AND RECONSTRUCTIVE SURGERY

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SINCE many plastic operations involve a knowledge of the various types of skin grafts and indications for their individual application, I wish to open this discussion by reviewing that phase of the work.

Skin grafts have a wide variety of applications, being used to cover surface defects of many sources.[1] Frequently, they are utilized to repair skin destruction resulting from burns and to replace tissue lost from injury and extensive resection for malignancy, especially those of the breast and about the head.

Except in identical twins, the transfer of skin from one person to another is futile. It was once believed that if donor and recipient were of the same blood group, success would follow grafting operations. The grafts may grow at first, but they soon melt away.

There are, however, two tissues that can be successfully transferred from one individual to another: cartilage and cornea. The reason for success with these tissues is probably the fact that neither has a blood supply, their nourishment being obtained by absorption from the adjacent soft tissues.

Zoografting, the transfer of animal tissue to human beings, is spectacular, but 100 per cent unsuccessful. It is rare that one cannot find enough material on the patient to adequately supply all of the grafts needed.

Skin grafts may be arbitrarily classified into the free and pedicle varieties. Free grafts may further be subdivided into part-thickness grafts and free full-thickness grafts.

PART-THICKNESS SKIN GRAFTS

For the sake of simplicity and certainty of take, the split type of graft is most useful. The very thin epidermal, or Thiersch, grafts are good for the rapid covering of defects where cosmesis and function are not important. They will not, however, control subsequent underlying scar contraction.

We have not found pinch grafts very practical in spite of what is commonly taught. It has been our experience that larger grafts grow better and give a much better final result. Pinch grafts give rise to considerable subsequent contraction due to scarring between the grafts. They likewise give the poorest cosmetic result. Carcinoma occasionally develops in pinch grafted areas, since these poorly vascularized surfaces easily break down. Any of these conditions may give rise to the necessity of excision and regrafting with another type. Although we admit their usefulness in the hands of the occasional operator, as time goes on they are being used less and less by the trained plastic surgeon because of the poor results obtained. It must be realized, however, that more skill and care are required in the use of large split grafts, free full-thickness grafts and pedicle flaps, and that the

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surgeon performing such operations only occasionally is apt to have many serious failures.

In more recent years, the thicker or intermediate split graft has found a very extensive field of usefulness and has practically supplanted the older, thinner Thiersch and pinch types. This variety has been named thick razor graft by Gillies and split skin graft by Blair. In reality, it is cut as a thick Thiersch graft and should contain 60 to 80 per cent of the thickness of the skin. It includes the papillary layer of the corium and tends to control subsequent scar contraction. In many instances, it gives nearly as good cosmetic results as the free full-thickness graft. At the same time, it is as simple to manage as a Thiersch graft. These may be quickly cut into various sizes and shapes and, under proper surgical technic, one can be sure of a practically 100 per cent take. Furthermore, the donor site heals without the necessity of closure by other means. For practical purposes, this type of graft is probably one of the most useful and can be used on many areas of the face and other mobile sites where the more complicated free full-thickness or Wolfe graft formerly has been employed. Not only is its entire management simpler and more certain, but also the time consumed in handling any given case is about half of that necessary where full-thickness grafts are used. Small and large areas can be covered with equal ease and success. These grafts grow very well on a granulating bed, but the result is not usually so satisfactory as it is when the granulations are first removed. They may also be placed upon a freshly prepared bed after excision of a healed scar or new growth. (Figs. 3 and 15.)

Fig. 1.—Forehead flap turned down to cover extensive nasal defect. The denuded area of the forehead is covered by a free full thickness graft.

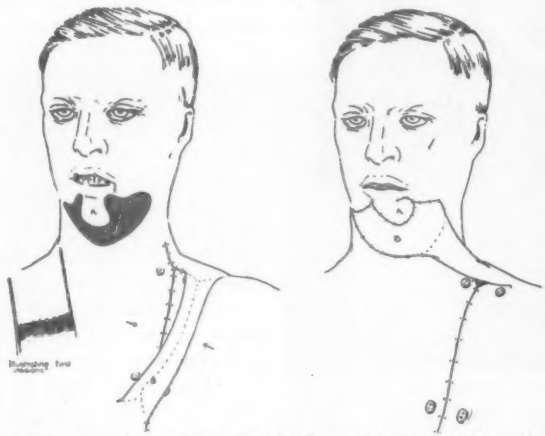

Fig. 2.—Construction and transfer of tube pedicle flaps. (After Gillies.)

We have had the greatest uniform success in the cutting of split skin grafts by following Blair's technic; i.e., by use of the suction retractor.

Having been cut to the desired size, the graft is transferred to the recipient area. Once applied to its new bed, it is secured in place under normal tension by fine non-absorbable sutures. It is not necessary to trim off the edges to the exact size of the bed. Any overlapping can be excised at the time of the first dressing. Gentle pressure is then exerted to express any fluid from beneath the graft, and a pressure dressing is immediately applied.

Fig. 3.—Donor site covered with thick razor grafts.

The donor site is covered with sterile 3 per cent xeroform vaselin gauze, dry cotton pads and a firm bandage. This is not usually touched for about ten days, at which time the dressings are soaked off. Usually, it will be found that the underlying area is completely healed.

The graft is usually inspected in from five to seven days, but may be examined sooner if necessary. The sutures and excess graft are then removed. If possible, one should expose the graft to the air at this time. Massage and motion can ordinarily be started with safety in from twelve to fourteen days.

STENT GRAFTING

Stent grafting is useful for covering mucous membrane surfaces, such as in the mouth or nostril, or for the application of free split grafts to any other depressed, curved or irregular surface.

A piece of soft sterile dental modeling compound or Stent composition is pressed into the previously prepared recipient area and an impression made of the defect. A split graft with the raw surface outward is then placed over the model, which is next reinserted in the pocket and secured in place. After ten days, the mold is removed and the raw surface will be found completely epithelized.

FREE FULL-THICKNESS GRAFTS

Free full-thickness, or Wolfe, grafts are most useful for a fresh, clean raw surface where good mobility with a minimum of secondary contraction and the best possible cosmetic result are desirable. Their usefulness, then, naturally applies to certain deformities about the face and hands. The use and the after-care are more complicated, and the certainty of a take is less than with the thinner or intermediate grafts. To insure uniform success of free full-thickness grafts, the following principles must be observed:

1. The graft must be cut to the exact size of the defect to be covered.
2. The base must be free of fat.
3. Hemostasis must be perfect.
4. The edges must be carefully and accurately approximated and the skin maintained under normal tension with fine interrupted non-absorbable sutures.
5. The graft must be secured to its base by firm, even pressure at about 30 mm. of mercury.
6. It must be immobilized for from ten to fourteen days unless some obvious complication warrants an earlier inspection of the graft. (Figs. 5 and 17.)

PEDICLE GRAFTS

The more simple pedicle grafts are the rotated flaps from the border of the defect wherein the pedicle graft is derived from a site immediately adjacent to the wound. (Fig. 1.) When this cannot be done, the flap is raised at some distant point and later transferred to the recipient site. When one wishes to transfer a subcutaneous fat pad with the skin graft, it is always necessary to use a pedicle graft. The late Professor Lexer, of Munich, devised a very ingenious bitemporal pedicle flap from the scalp, which was swung down to cover extensive facial defects in men. Although it has many advantages on the continent, very little useful application is found in America, since most men in this country refuse to wear full beards. Although these grafts may be shaved, the owner finds an extremely tough beard over which to labor.

In dealing with certain types of linear scar contractures, especially those involving the flexor surface of joints and certain types of neck contractures, the Z-plastic, which involves the creation of two rotated pedicle flaps, will often afford sufficient relaxation to make further surgical procedure unnecessary for adequate functional results. (Figs. 14 and 16.)

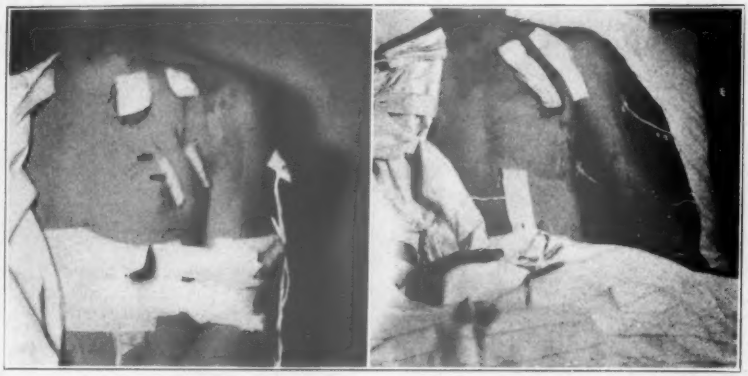

Fig. 4.—Case similar to that shown in Figure 3.

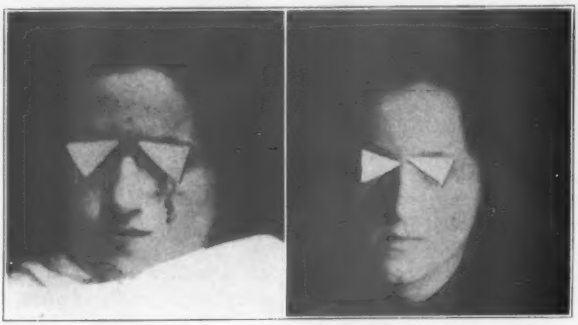

Fig. 5.—Left: Old scar resulting from radium application for cure of hemangioma at age of 1 year. Right: Appearance of patient after excision and replacement with free full thickness skin graft.

TUBE PEDICLE GRAFTS

Probably the most useful vascular transplant is the tube pedicle variety. Its use permits the graft to be taken from a distant point where the subsequent scarring is on an area not ordinarily exposed to view. These flaps are usually taken from the neck, pectoral region or upper arm. They may also be raised from the abdomen and brought up to the face by the caterpillar method or, more rapidly, by the "jumpflap" method, whereby the wrist, acting as an intermediate host, is used as a carrier.

Fig. 6.—Healed lateral nasal fracture. A wedge of bone must be removed from the broader side before the framework can be replaced in the midline.

These tubes are constructed by first making two parallel skin incisions in the area selected to give the most useful graft for the problem at hand. (Fig. 2.)[2] They should be no more than two and one-half times as long as they are wide, for fear of endangering the blood supply. Incisions are carried through the skin and fat, and then undercut from one side to the other, leaving a strip of skin with its ends attached. Hemostasis of the raised flap is perfected and its edges then rolled together and sutured beneath. The donor site is covered by undercutting the adjacent skin margins, after which the edges are advanced to the center of the wound and sutured beneath the tube. In extremely large tubes,[2] the raw surface may be covered with a split skin graft if the tension on the lateral flaps seems unduly great. (Fig. 3.)

An exception may be made regarding the proportions. If there is need for an extremely long skin flap, the tube may be raised in two or three sections, intervening segments or bridges of skin being left attached to insure adequate vascularity. (Fig. 4.) Later, these bridges may be gradually cut across as the blood supply of the ends becomes sufficient to keep the tube alive.

Fig. 7.—Healed depressed or telescoping nasal fracture.

The tube is then dressed and left in this position for from two to three weeks; that is, until it becomes well vascularized or, better still, until all induration and reaction have disappeared. At the end of this time, the distal end is cut across and the tube reopened and sutured into the recipient area. The proximal end of the tube remains attached until the

graft has become securely vascularized in its new bed. The tube is then cut across and the excess portion returned to its original site or discarded.

PLANNING THE TYPE OF REPAIR

To be successful, the surgeon must be able to imagine his case in the final healed state. In other words, he must have a clear vision of the ultimate result before he begins the repair. This is just as important as a knowledge of the operative steps involved.

In planning the repair of any cutaneous defect, the procedure of choice can

Fig. 8.—Dislocation of left alar cartilage into nostril with resulting collapse of ala.

be determined only after an accurate diagnosis of the existing pathologic condition has been made. Once this is established, the logical procedure is usually quite obvious. One must keep in mind the ease with which the area can be covered, the final cosmetic and functional result and the comfort and safety of the patient during the period he is under the surgeon's care. Likewise, one must avoid, as nearly as possible, producing further defects in order to repair the original one.

Pedicle grafts are desirable when maintenance of the viability of the graft is doubtful. When they can be obtained nearby, simple pedicle or rotated flaps usually suffice. If one must go a distance for vascularized grafts, the tube pedicle becomes the choice. For reconstruction about the nasal tip, lips and chin and for larger cheek defects, tube pedicle grafts are almost a necessity. For total nasal covering, the older Italian method should be condemned because of the danger of emboli and the irksome position for the patient.

When there is a healthy base against which proper pressure can be made, some type of free graft should always be used, for obvious reasons of simplicity.

SPECIFIC LESIONS

Fresh Lacerated Wounds and Abra-

Fig. 9.—Dislocation of quadrilateral cartilage into right nostril.

sions.—Lacerations should be carefully cleansed with soap and water and all bleeding points ligated. The edges should then be accurately approximated with fine non-absorbable suture material. The stitches should be removed early.

If abrasions contain dirt, cinders or other foreign bodies, they should be removed at once under anesthesia. Soap and water should be used, or benzine if grease or paint is embedded. Failure to remove foreign matter will permit it to become fixed in the skin, a permanent tattoo resulting.

Simple Scars and Keloids.—Simple scars are excised down to the subcutane-

ous tissue. The borders are mobilized by undercutting the adjacent skin edges, after which they are accurately sutured without tension.

In my experience with keloids, best results have been obtained when a combination of radiotherapy and surgical operation is employed.

Thermal Burns.—It is generally accepted that all burns should be grafted as early as possible. The patient may be spared unlimited discomfort and great expense by having the wounds closed in a short time by a permanent covering. Moreover, one also eliminates the horrible defects, some of which may be permanent, that result from the contraction of scars which would otherwise develop.

X-Ray and Radium Burns.—Unlike simple burns with limited destruction, x-ray or radium burns cause local arterial damage resulting in a covering tissue of poor vitality. This tissue frequently breaks down and an ulceration that will not heal results. Secondary malignant changes may ensue in cases of long-standing radionecrosis. X-ray and radium burns also give rise to much pain and intolerable itching, in addition to ulceration and discharge.

There is only one satisfactory method of therapy and that is complete excision back through an area of good blood supply and down to a healthy base. As soon as this is carried out, the patient will be freed of the pain and itching, immediately and permanently. Except

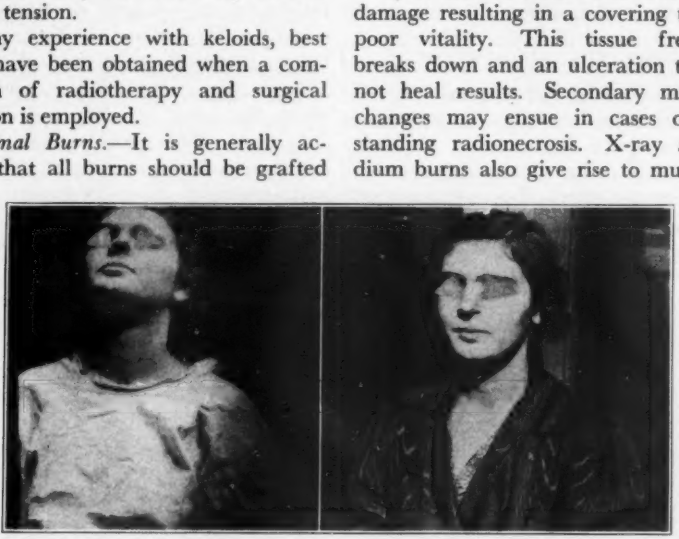

Fig. 10.—Left: Deviation to left and diminution in size of left half of nose due to pull of neglected dense scar in left nasolabial fold, following application of radium in infancy for cure of hemangioma. Right: Result of excision of scar, shifting bony framework to right and filling in resulting defect in left side with tube pedicle graft from forearm.

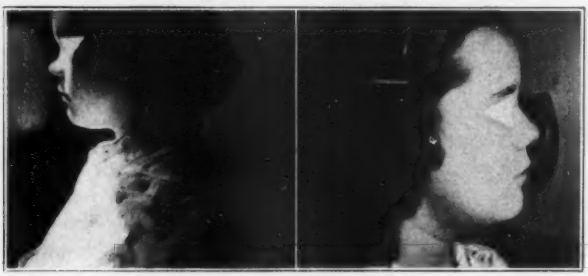

Fig. 11.—Saddle defect (left) corrected by iliac bone graft (right).

in the case of excision of an acute or badly infected ulcer, the area may be grafted at once. In the case of an ulcer, it may be desirable to divide the operation into two stages and allow the base to granulate before grafting. (Fig. 5.)

Nasal Deformities.—The plastic repair of nasal defects offers many surgical problems. One or more of three factors have to be dealt with; namely, the external skin covering, the mucous membrane lining and the intermediate mechanical support. Although nasal injuries may seem to be of minor importance, they actually constitute a major part of the field of plastic surgery. Their

Fig. 12.—Method of Gillies and Kilner.

correction is likewise often a major surgical task.

Of the bony injuries, two types of fracture of the nasal bones are most commonly seen:

1. Lateral fractures (Fig. 6), usually following a blow from one side and causing lateral displacement of both the nasal bones and the septum without much change in the contour of the bridge.

2. Telescoping nasal fractures, following blows applied from in front. These fractures are usually badly comminuted, the nasal bones being forced to override between the nasal processes of the superior maxillae. This causes a widening and depression of the nasal bridge. The septal cartilage is frequently dislocated and, in many cases, large portions may be lost as a result of the trauma, and a severe saddle type of collapse secondary to lack of this underlying support ensue. (Fig. 7.)

Cartilage Injuries.—Probably the most common cartilage injury is a dislocation or separation of the alar cartilages. The former causes a collapse of the ala and an obstruction to the air passage due to the presence of the cartilage in the vestibule. (Fig. 8.) Separation of the alar cartilages from the midline results in widening of the tip and often a small cleft or depression in the central portion of the tip.

Dislocation of the lower end of the quadrilateral cartilage may occur, both in conjunction with bony injuries and as a separate entity. In the latter condition, a deviation of the nasal ridge toward the side of dislocation is usually noted. The presence of the dislocated cartilage in the vestibule also causes a certain amount of obstruction to the airway on that side. (Fig. 9.)

Injuries to Soft Tissues.—Lacerations constitute the commonest injury to the soft tissues. These occur both in the skin and through the mucous membrane.

At times, complete loss of portions of the external skin or mucous membrane, or even parts of the nose such as an ala or the nasal tip, may occur. The latter constitute a much more serious type in view of the repair that becomes necessary.

Scar contractions due to burns constitute another serious menace in the production of nasal deformities. If these occur before adult life and are not corrected, the pulling causes serious maldevelopment of the underlying bony framework. (Fig. 10.)

Treatment of Nasal Injuries.—In general, all nasal fractures, as well as injuries to the soft tissues, should be corrected as early as possible. If nasal fractures are

seen early, they can usually be corrected by simple elevation and maintenance of position by one of several accepted methods of immobilization.

In more severely impacted fractures and in all old healed fractures, open operative correction becomes the only remaining method for satisfactory restoration.

The treatment of old depressed nasal fractures rarely succeeds in reducing the telescoping that has occurred. Thorough comminution of the nasal bones and nasal processes of the maxillae through intranasal incisions will ordinarily repair the deformity in the bony arch. If the tip needs to be built out, a hinged costal cartilage graft which contains both dorsal and vertical struts is necessary. If there is only the saddle defect and a good tip, a rib cartilage or bone graft taken from the iliac crest furnishes an excellent means of corrective support. (Fig. 11.)

Dislocation of the alar cartilages is corrected only by dissection through vestibular incisions and by restoration to their normal position. In separation of the alar cartilages, repair is made by thoroughly freeing the cartilages from the overlying soft parts and suturing them in the midline.

Fractures of the Malar-Zygomatic Compound.—There are three common methods utilized to correct this deformity. The first two are mentioned briefly to point out their bad features. The first method consists of threading a hook or a wire beneath the arch through the overlying facial skin. If the impaction is not too great, the fragments may then be elevated into normal position.

The second method, open reduction by

Fig. 13.—Left: Old multiple burn deformities with apparent loss of left ear. Auricular cartilage could be palpated beneath and was utilized as described in text. Center and right: Results.

Fig. 14.—Healed linear scar contracture of neck (left) corrected by Z-plasty (right). Lines indicate method of delineating and transposition of flaps.

incision through the cheek, may be criticized for disregarding one of the fundamental principles of plastic surgery; that is, to avoid the addition of further defects to the original deformity.

The third method is that developed by Harold Gillies and his former associate, T. P. Kilner, of London.[4, 5] Preferably under general anesthesia, a small curved incision is made, under aseptic technic, through a shaved area in the temporal region. (Fig. 12.) This should be made within the hairline where the resulting scar will not be visible. The incision is carried down to the temporal fascia. The wound edges are then retracted, while another incision is made through the temporal fascia, thus exposing the temporal muscle. Through this opening, a long thin metal elevator is passed downward superficially to the temporal muscle, until it comes to lie under the depressed zygomatic-malar bones. The scalp above the wound is then protected with a block of sterile gauze and the finger of the opposite hand is placed over the fractured area to follow the progress of the reduction. By simple levering movements, the fragments can then be quite easily manipulated into correct position.

In the case of old healed deformities, a similar technic may be followed by first refracturing the bone with a thin bladed chisel passed through the temporal incision and then manipulating the fragments as described before.

The fracture once reduced, the bone will stay in place without additional aid because there is no muscular pull to displace it. The temporal wound is closed without drainage with a few interrupted sutures, and sterile dressings are applied.

Fractures of the Maxillae.—Fractures of the maxillae and mandible should be reduced early and immobilized by wiring of the appropriate teeth. Obviously, dental consultation should always be obtained so that malocclusion of the teeth will not be permitted to occur.

Otoplasty.—Complete or partial reconstruction of the external ear is one of the major problems in plastic surgery. Many principles of plastic surgery are involved.

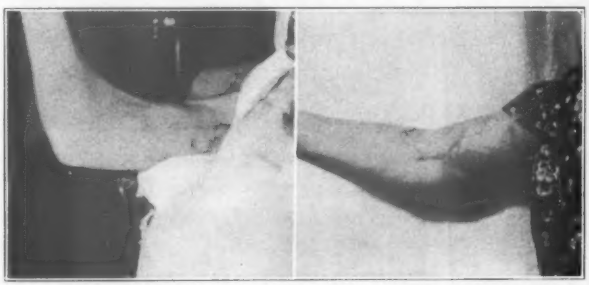

Fig. 15.—Left: Narrow web contracture following healed burn. Right: Result of excision and replacement with single thick razor graft.

The chief stumbling block in rebuilding a new ear lies with the problem of furnishing adequate support to the overlying skin. The numerous curves and concavities of the normal ear cartilage make replacement of this tissue an important undertaking. Until recently, costal cartilage or bone was utilized for this purpose, but since neither source gave adequate material from which one could carve a structure that even feebly represented the normal auricle, the operation was usually a disappointment to both operator and patient.

The latest contribution,[6] and indeed

one which offers great promise, depends on the utilization of an ear cartilage from another individual, usually a woman, who can cover the donor site with her hair. This cartilage is buried beneath the skin of the mastoid process and, at a later date, the cartilage, which is now covered anteriorly by skin, is swung forward on an anteriorly attached pedicle. The posterior defects are covered with a Stent graft and the operation is complete.

The same principle is utilized to reconstruct an ear whose cartilage has been buried by burn scars; i.e., elevating and covering the posterior aspect of the cartilage and mastoid bone with a Stent graft. (Fig. 13.)

If all or part of an ear has just been lost in an accident and the lost portion is completely detached, immediate suturing of the detached part in place holds practically no promise of success; but the cartilage should be saved for future reconstruction. If it is not feasible to bury it under the mastoid skin at once, it may be sutured into a subcutaneous pocket in the abdominal wall until it can be placed in its permanent location.

Chronic Varicose Ulcers.—The majority of these lesions can be eradicated by ligation and injection of the associated varicose veins. If the ulcer persists, surgical intervention becomes necessary.

Grafts will not ordinarily grow on the granulating bed of a chronic varicose ulcer. One must first excise the ulcer well beyond its borders and down to the underlying muscles, tendons and periosteum of the tibia. In so doing, a cicatrix, measuring from one-fourth to one-half inch thick is removed. It does not take much imagination to realize why these ulcers do not heal, since only a very poor blood supply can penetrate this dense scar.

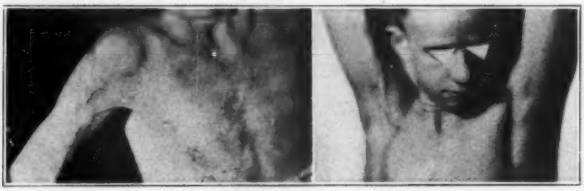

Fig. 16.—Left: Old healed burn contracture of right axilla. Right: Result of correction by Z-plasty.

Fig. 17.—Left: Burn scar contracture of fourth and fifth fingers. Center and right: Results of excision and covering of area with free full thickness skin grafts.

After removal, the base is allowed to granulate, and, in from twelve to eighteen days, the bed is ordinarily ready for the application of split skin grafts.

Scar Contractures of the Extremities.—Neck contractures should be corrected by a Z-plastic or grafted after excision of the scar. (Fig. 14.) Because of the narrow skin flaps, elbow contractures nearly always necessitate a graft. (Fig. 15.)

Axillary contractures are ordinarily of two types. The tight contracting variety

must be corrected by the implantation of a graft, but those having available skin flaps can be managed with a Z-plastic. (Fig. 16.)

Contracture of the fingers is best repaired by excision and grafting with free full-thickness skin grafts. (Fig. 17.)

It has been my intention to better acquaint you with a somewhat broader view of present day plastic surgery. I have purposely avoided problems dealing with oral surgical repair, since it is a field with which the dental profession already is well acquainted.

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FACTORS IN SALIVA CORRELATED WITH THE OCCURRENCE OF CALCULUS*

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In a previous report,[1] it was shown that stimulated saliva of a group of persons who tend to form calculus differed in several respects from that of a calculus-free group. The most striking differences appeared in total calcium and inorganic phosphate, the mean values of which were less in the calculus-free than in the calculus group. Smaller differences were found for pH and protein. The mean pH value was lower, and the mean protein content was higher in the calculus-free than in the calculus group. More recently, in a study of stimulated saliva of Alaskan Eskimos with and without calculus,[2] differences similar to those previously reported[1] were found between the two groups in calcium and inorganic phosphate.

The present report includes further analyses of stimulated saliva and initial studies of unstimulated saliva. As in the previous study,[1] the calculus group included individuals who had heavy deposits on the lingual surfaces of the lower anterior teeth. Most subjects, however, had heavy deposits both on the lingual surfaces of the lower anterior teeth and on the buccal surfaces of the upper molars, or throughout the mouth. Persons with small deposits on the lingual surfaces only of the lower anterior teeth, but who had not had dental prophylactic treatment for at least three years, were not included. The calculus-free group consisted of individuals who were free from calculus although they had not had dental prophylactic treatment for at least one year. The age

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range of the subjects studied was between 20 and 60 years. Two or three sets of analyses of unstimulated saliva were performed in about 90 per cent of the cases, while stimulated saliva was analyzed once in most cases.

METHODS

Stimulated saliva was collected while the subject was chewing paraffin; unstimulated saliva was obtained with minimum movement of the tongue, cheeks, lips and jaw. Collections were made in three successive portions, from one to three hours after breakfast. The first portion, collected under paraffin oil, was used to determine the initial pH. The second portion was used for the analyses of total calcium, inorganic phosphate and protein. The third portion, again collected under oil, was used for a final pH determination. The quantities collected in the first, second and third portions were from 1 to 2 cc., 10 to 12 cc., and 1 to 2 cc., respectively, of stimulated saliva, and 0.5 to 1 cc., 5 to 6 cc. and 0.5 to 1 cc., respectively, of unstimulated saliva. There was no appreciable difference between the calculus-free and calculus groups in the rate of flow of both unstimulated and stimulated saliva. The analytic procedures were similar to those used previously.[1]

TABLE 1.—ANALYSIS OF UNSTIMULATED SALIVA OF CALCULUS-FREE GROUP

Case No.	Number of Sets of Analyses	Age	Total Calcium	Inorganic Phosphate	Protein	Initial pH	Final pH
			Mg./100 Cc.				
6	2	25	6.8	16.3	452	6.80	6.90
8	2	44	5.1	11.0	260	6.60	6.70
11	2	31	5.0	17.1	320	7.00	7.00
12	2	36	6.9	24.8	413	6.55	6.78
21	2	39	5.9	16.0	333	6.75	6.93
22	2	25	6.4	9.9	251	6.83	6.93
23	1	33	3.4	10.0	243	6.90	7.15
31	2	32	5.4	23.3	263	6.60	6.65
42	1	28	4.4	15.2	163	6.85	6.95
47	1	35	5.3	18.9	310	6.70	6.70
48	2	20	6.4	21.4	317	6.75	6.85
49	2	42	6.8	18.5	294	6.73	6.93
52	2	23	5.3	22.5	469	6.60	6.75
54	2	21	5.7	11.3	145	6.98	6.98
59	2	23	4.7	16.6	217	6.70	6.78
63	2	30	5.7	22.0	332	6.65	6.70
64	1	31	5.6	19.2	308	6.80	6.90
65	2	27	6.5	13.4	269	6.88	7.00
Mean		30.2	5.6	17.1	298	6.76	6.86
Standard deviation			0.94	4.80	77.0	0.128	0.13
Standard error of mean			0.23	1.16	18.7	0.03	0.03

The statistical method employed for the interpretation of the results was the standard procedure of dividing the difference between the means of two groups by the standard error (standard deviation) of the difference to determine the probability that the observed difference was not due to chance.

RESULTS AND CONCLUSIONS

Unstimulated Saliva.—The findings for

unstimulated saliva of individual cases are given in Tables 1 and 2. The statistical analyses of the data is presented in Table 3. As in the previous report for stimulated saliva, the most striking difference between the calculus-free and calculus groups appeared in the calcium content of the saliva. The mean value for calcium in the calculus-free group was lower than that in the calculus group, the difference between the means being 4.6 times its standard error. A difference of this magnitude would be likely to occur by chance once in 100,000 times. The mean value for inorganic phosphate was likewise lower in the calculus-free than in the calculus group, and since the difference is 2 times its standard error, it may be regarded as statistically significant. The differences between the groups for protein and pH are not significant.

TABLE 2.—ANALYSIS OF UNSTIMULATED SALIVA OF CALCULUS GROUP

Case No.	Number of Sets of Analyses	Age	Total Calcium	Inorganic Phosphate	Protein	Initial pH	Final pH
			Mg./100 Cc.				
1	2	58	5.5	17.5	245	7.03	7.10
2	2	32	7.2	25.7	347	6.73	6.80
3	2	59	7.9	19.1	270	6.65	6.75
4	2	42	6.5	21.3	217	6.88	7.03
9	2	31	6.8	19.6	315	7.00	7.00
10	3	43	8.7	20.0	418	6.88	7.10
14	2	49	7.2	21.6	634	6.48	6.80
18	2	21	7.7	17.4	249	7.25	7.35
24	2	48	5.8	15.6	355	6.58	6.78
25	3	45	6.6	17.1	289	6.93	7.03
27	3	30	6.5	18.5	371	6.70	6.98
28	2	48	9.8	16.6	421	7.03	7.18
30	2	38	7.0	26.2	333	6.50	6.48
32	2	31	7.5	17.6	223	6.68	6.65
33	2	60	7.7	27.0	640	6.83	7.20
38	2	50	5.0	19.6	228	6.88	6.88
40	2	46	7.4	16.8	262	6.88	6.90
41	3	30	7.9	24.0	320	6.78	6.83
43	3	50	6.2	14.2	255	7.30	7.33
45	2	43	4.6	14.5	285	6.70	6.80
50	2	32	7.0	24.7	291	6.53	6.63
53	2	47	6.2	21.5	229	6.98	6.90
55	2	39	6.3	13.5	412	6.73	6.75
56	2	42	7.1	19.1	439	6.75	6.73
60	3	31	7.2	23.1	360	6.72	7.02
61	2	55	8.3	24.2	413	6.50	6.65
62	3	54	8.9	21.8	626	6.23	6.52
44	2	22	7.6	16.4	304	6.50	6.93
Mean		42	7.1	19.8	348	6.77	6.90
Standard deviation			1.12	3.67	117.8	0.23	0.22
Standard error of mean			0.21	0.71	22.7	0.05	0.04
Mean after taking out 13 cases between 45 and 60 years		33.8	7.0	20.1	326	6.75	6.81

TABLE 3.—STATISTICAL ANALYSIS OF DATA OF UNSTIMULATED SALIVA OF CALCULUS-FREE AND CALCULUS GROUPS

Class of Value	Group	Group Mean (M)	Standard Error of Mean	Difference Between Means (D)	Standard Error of the Difference (σ D)	$\frac{D}{\sigma D}$	Odds Against Chance Occurrence of Difference Between Means
Calcium Mg./100 cc.	Calculus-free	5.6	0.23	1.5	0.327	4.6	$>10^5$ to 1
	Calculus	7.1	0.21				
Inorganic phosphate Mg./100 cc.	Calculus-free	17.1	1.16	2.7	1.36	2.0	21 to 1
	Calculus	19.8	0.71				
Protein Mg./100 cc.	Calculus-free	298	18.7	50	29.40	1.4	5 to 1
	Calculus	348	22.7				
Initial pH	Calculus-free	6.76	0.03	0.01	0.0538	0.2	< 1 to 1
	Calculus	6.77	0.05				
Final pH	Calculus-free	6.86	0.03	0.04	0.0508	0.8	1 to 1
	Calculus	6.90	0.04				

TABLE 4.—MEAN VALUES FOR STIMULATED SALIVA OF CALCULUS-FREE AND CALCULUS GROUPS

Type of Case	No. of Cases	No. of Sets of Analyses	Age	Total Calcium (Mg./100 Cc.)	Inorganic Phosphate (Mg./100 Cc.)	Protein	Initial pH	Final pH
Second Series — New Data								
Calculus-free	15	17	30	5.1	12.1	276	7.02	7.26
Calculus	30	37	42	6.6	14.2	286	7.16	7.37
First Series — Previously Published								
Calculus-free	19	52	29	5.1	11.8	314	6.99	7.21
Calculus	29	79	38	6.7	13.6	294	7.09	7.30
First and Second Series Combined								
Calculus-free	34	69	29.6	5.1	11.9	298	7.00	7.23
Calculus	59	116	40.0	6.7	13.9	289	7.12	7.33
First and Second Series Combined Minus Twenty-Two Cases Between 46 and 60 Years in the Calculus Group in Order to Equalize More Nearly Average Ages of Two Groups								
Calculus-free	34	69	29.6	5.1	11.9	298	7.00	7.23
Calculus	37	78	33.3	6.6	13.9	277	7.15	7.35

Stimulated Saliva.—The results of the additional analyses of stimulated saliva are given in Table 4, which contains in addition the mean values previously published[1] and the means of the combined first and the second series. Except for protein, the new data are in essential agreement with those previously pub-

lished.[1] The results of the statistical analyses of the combined series are given in Table 5. The mean values for calcium and inorganic phosphate in the combined series were lower in the calculus-free than in the calculus group, the differences between the means for calcium and inorganic phosphate being respectively 7.2 and 4.1 times their standard errors. The differences observed between the groups for calcium and for inorganic phosphate would therefore be likely to occur by chance less than once in a billion times for the former, and once in about 15,000 times for the latter. Both the initial and the final pH values were likewise less in the calculus-free than in the calculus group, and the ratio of the differences to their standard errors in each instance is such as to make it unlikely that the differences between the groups could be attributed to chance. The small difference between the groups for protein is definitely of no significance.

The effect on the validity of the conclusions of combining the new data with those previously published[1] is worthy of note. Although, except for protein, there was no essential difference between the results of the two studies (Table 4), it was found that the addition of the present series of cases to those previously reported has greatly increased the probability that the differences observed are significant.

TABLE 5.—STATISTICAL ANALYSIS OF DATA OF STIMULATED SALIVA OF CALCULUS-FREE AND CALCULUS GROUPS
First and Second Series Combined

Class of Value	Group	No. of Cases	Group Mean (M)	Standard Error of Mean	Difference Between Means (D)	Standard Error of Difference (σ D)	$\frac{D}{\sigma D}$	Odds Against Chance Occurrence of Difference Between Means
Calcium Mg./100 cc.	Calculus-free	35	5.1	0.157	1.6	0.22	7.2	>1011 to 1
	Calculus	58	6.7	0.15				
Inorganic phosphate Mg./100 cc.	Calculus-free	34	11.9	0.40	2.0	0.49	4.1	15,770 to 1
	Calculus	59	13.9	0.29				
Protein Mg./100 cc.	Calculus-free	34	298	12.08	9.0	15.3	0.6	<1 to 1
	Calculus	59	289	9.5				
Initial pH	Calculus-free	35	7.00	0.035	0.12	0.046	2.6	106 to 1
	Calculus	59	7.12	0.03				
Final pH	Calculus-free	35	7.23	0.034	0.10	0.043	2.3	46 to 1
	Calculus	59	7.33	0.028				

ANALYSES OF SALIVA BEFORE AND AFTER PROPHYLAXIS

Since the possibility existed that particles of calculus may have been added to saliva during collection and thus the calcium and the inorganic phosphate contents may have been affected, analyses of unstimulated and stimulated saliva were made in eleven subjects, before and after dental prophylaxis (Table 6). The average values show little difference before and after prophylaxis. In some instances, the amounts of calcium and phosphate, or both, found in saliva after prophylaxis were reduced, while in others they were increased. The differences in

individual cases before and after prophylaxis, in both unstimulated and stimulated saliva, were in general similar to those found in samples of saliva collected from the same individual on different days before prophylaxis.. It may therefore be concluded that extraneous matter which may affect the calcium or inorganic phosphate content of the saliva was not added during collection. The results obtained for protein and pH, before and after prophylaxis, lead to similar conclusions. These results also indicate that the findings reflect the tendency toward calculus formation rather than the effects of the presence of calculus.

INFLUENCE OF AGE ON SALIVARY CONSTITUENTS

The age range and average age of the calculus-free group was less than that of the calculus group. In order to eliminate the possible influence of age as a factor in the differences between the two groups, the mean values in the calculus group were recalculated after removal of thirteen of twenty-eight subjects

TABLE 6.—MEAN VALUES FOR SALIVA BEFORE AND AFTER PROPHYLAXIS

	Before Prophylaxis						After Prophylaxis				
	No. of Cases	Total Calcium	Inorganic Phosphorus	Protein	Initial pH	Final pH	Total Calcium	Inorganic Phosphorus	Protein	Initial pH	Final pH
		Mg./100 Cc.					Mg./100 Cc.				
Unstimulated saliva	11	6.8	18.6	348	6.80	6.91	6.7	17.7	322	6.90	7.0
Stimulated saliva	11	7.0	13.2	296	7.13	7.28	6.6	13.9	259	7.12	7.28

TABLE 7.—RELATIONSHIP OF CALCIUM AND INORGANIC PHOSPHATE TO AGE IN CALCULUS-FREE AND CALCULUS GROUPS

	Calculus-Free					Calculus				
	No. of Cases	Age Range	Average Age	Total Calcium	Inorganic Phosphorus	No. of Cases	Age Range	Average Age	Total Calcium	Inorganic Phosphorus
				Mg./100 Cc.					Mg./100 Cc.	
Unstimulated saliva	7	20–27	23.0	6.0	15.9	11	20–39	30.6	7.2	22.7
	7	28–35	31.0	5.0	18.0	10	40–49	45.0	7.0	18.4
	4	36–44	40.0	6.2	17.7	7	50–60	55.0	7.0	20.5
Stimulated saliva	17	20–27	23.4	5.1	11.2	27	20–39	30.0	6.5	13.5
	9	28–35	32.0	4.6	13.4	19	40–49	44.7	6.8	14.0
	8	36–46	39.7	5.4	11.6	13	50–60	53.7	6.9	14.7

between the ages of 45 and 60 in the unstimulated saliva series and twenty-two of fifty-nine subjects between the ages of 46 and 60 in the stimulated saliva series. This gives similar age ranges in both groups, but a slightly higher average age in the calculus group than in the calculus-free group—approximately 33 years in the former as compared with 30 years in the latter. It is clear from Tables 2 and 4 that the recalculated means are closely similar to the original means. As an additional check, the data for calcium and phosphate have been regrouped into various age ranges as shown in Table 7.

It appears that there is no definite trend with age within the age range studied for both the calculus-free and the calculus groups in the case of unstimulated saliva, and for the calculus-free group in the case of stimulated saliva. There is a trend with age for the phosphate content of stimulated saliva in the calculus group, but in view of the mean values obtained when twenty-two subjects between 46 and 50 years were eliminated from this group (Table 4), this effect may be discounted as a factor in the difference in mean values between the two groups.

SUMMARY

In both unstimulated and stimulated saliva of adults, the most striking difference between the calculus-free and calculus groups appeared in the calcium content of the saliva. The mean values for calcium were lower in the calculus-free than in the calculus group, the differences being statistically significant. The mean values for inorganic phosphate were likewise lower in the calculus-free group for both types of saliva, the difference between the two groups being statistically valid in the case of stimulated saliva. For unstimulated saliva, it is also likely that the difference between the means is not due to chance. No significant differences between the groups were found for protein in either unstimulated or stimulated saliva, or for pH in the former. However, the difference between the groups for the pH of stimulated saliva may be regarded as significant.

The average values for calcium and inorganic phosphate show little difference before and after dental prophylaxis, indicating that the findings reflect the tendency toward calculus formation rather than the effects of the presence of calculus.

These findings indicate that the average concentrations of total calcium and inorganic phosphate in both unstimulated and stimulated saliva, and the average pH of stimulated saliva of persons who form calculus, are relatively such as to favor the precipitation of the inorganic salts found in the deposit.

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BITE-OPENING DANGERS

By JOHN V. MERSHON, D.D.S., Sc.D., Philadelphia, Pa.

IN the quest for relief of every human ill, medicine has met with defeat every time it has ignored one unalterable condition of humanity—individual limitations. In the germ cell is present every developmental possibility that can ever be realized in the adult into which that cell will develop. Prenatal and postnatal environmental influences may *prevent* the individual from developing to the full limit of these possibilities, but there is no influence that can ever make him *exceed* these limitations.

This discussion is limited to the field of prosthodontia. If prosthodontia were merely a problem of mechanics, the operator's task would be quite simple, but the complex biologic factors which must be recognized in this branch of dentistry make it one of the most difficult of specialties.

When we realize that each germ cell is different from all others and that each of the millions of changes which take place during the process of development to maturity makes each individual a being different from all other beings, how can we hope to lay down rules such as one might use in engineering? Nature presents all kinds of variations in individuals, ranging from the slight difference between the left and right sides of one person to the extreme variations seen in dwarfs and giants. All parts of the oral cavity, both individually and in their complex interrelationship, reflect these limitless variations.

Let us have a common understanding of the terms used in the title: "Bite-Opening Dangers."

The title presupposes that something detrimental to the tissues of the oral cavity occurs as a result of this procedure.

Bite I understand to mean the relation of the mandibular teeth to the maxillary teeth. When the muscles of mastication are at rest, there is a slight space between the occlusal surfaces of the maxillary and mandibular teeth. Normally, the teeth are in contact only a short time in twenty-four hours, but if the length of the teeth is increased by artificial means, the constant contact into which they are forced results in dangers which can be pointed out only after study of the tissues of the oral cavity.

Opening of the bite is an attempt to increase the vertical distance between the mandible and the maxillae beyond the above-mentioned relationship.

Danger I interpret in its broadest sense as potential injury, physical or mental.

The danger is principally to the tissues of the oral cavity. Therefore, we cannot isolate the teeth and bite and discuss them without regard to the tissues. The teeth and bite are part of a complicated organism which affects them and is, in turn, affected by them.

The tissues develop in harmony, and their interrelationship cannot be altered by the use of a mechanical device without disturbance of this harmony. All during development, the tissues modify each other and adapt themselves to each other, even though the organism, in its entirety, may constitute a deformity.

As a basis for later conclusions, let me restate what is known of the tissues of the oral cavity. Such a review embraces a

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study of development, structure and function. While this may seem a rather tedious study of anatomy, it is the way in which the subject can best be approached.

THE TISSUES

In a consideration of the tissues, I shall take up:

a. The osseous structure, including the alveolus.

b. The teeth and their attachments.

c. The muscular structure.

d. The nervous system.

Following this review, I shall show the interrelationship of the tissues in function and the effect of bite opening efforts upon them.

Bone, although hard, is the most plastic of the body tissues. It is built as the result of growth, an intrinsic property of every tissue of the organism. Bone, like other tissues, goes through a constant tearing-down and rebuilding cycle. During growth, the building-up process is in excess of the tearing-down process and, as a result, an increase in bulk occurs. After maturity, the two processes balance and the organism is kept in repair, but bulk is not increased.

The osseous structure has a dual function. First, it supports the muscles which are attached to it by tendons. Secondly, it provides something for the muscles to pull against in order that they may function. While the stimulating influence of muscle on bone may cause bone to change, it does not cause it to grow; that property is inherent in bone, as in all other tissues.

The alveolar bone is a specialized form of bone superimposed upon the true bone of the mandible and maxillae. There are two distinct alveoli, one of which holds the deciduous tooth, and the other, the permanent tooth. Their proportions are determined by the length of the roots of the teeth and their growth parallels that of the teeth.

Histologists tell us that the structure of the alveolar bone is like that of other bones. Its function, however, is quite different from any other part of the osseous structure. Other bones support muscles, but the alveolar bone has no muscular attachments. It serves solely as a tooth-bearing and tooth-supporting structure. The alveolar bone is influenced by muscle only as far as the muscles of mastication exert pressure upon it by way of the teeth.

The structure and function of the teeth are so well known that any discussion of them in this paper seems unnecessary except to state that there is a great variation in the size and proportions of teeth in different individuals as well as in one individual.

The teeth are attached to the alveolar bone by means of the dental periosteum. This tissue is composed of fibers one end of which is attached to the alveolar bone and the other to the cementum of the tooth. When the fibers of the dental periosteum are properly formed, they merge with the gingiva and support the teeth, at the same time limiting their movements.

Let us now consider the muscular structure. Muscles are composed of fibers which are nourished by the blood and stimulated by the nerves. Muscles lack elasticity, but have the power to contract and relax. After maturity, the muscles cannot be lengthened or shortened except as the result of disease or by surgery.

The function of muscle is contraction and relaxation. Muscles work in groups or pairs. When one of a pair is contracted, the opposing muscle is relaxed. One group of muscles opens the jaw and another group closes it. When both groups are at rest, a slight space is present between the occlusal surfaces of the mandibular and maxillary teeth. The length of the muscles which control the mandible determines the extent to which the posterior teeth erupt, but, regardless of the extent to which they erupt, when the muscles of mastication are at rest, there is always a space between the oc-

clusal surfaces of the posterior teeth. If this were not so, the muscles of mastication would be under a constant strain because they would always be stretched beyond the point at which they could relax completely.

As correlation in growth takes place, the adaptive change is always in bone, never in muscle. Bone is the passive tissue, muscle the active tissue. In other words, muscle cannot lengthen in order to accommodate an increase in bony bulk; bone adapts itself to the length of the muscles.

Muscles are only inert masses of tissue until they are made to function by the nervous system. There is nothing within a muscle itself which causes it to function. It cannot react until it is acted upon by the nerves which have received a message from the brain by way of the spinal cord and nerves.

There are sensory and motor nerves. Stimuli from the brain, by way of the motor nerves, cause the muscles to contract and relax. Sensations of well-being or discomfort in the muscles are carried to the brain by the sensory nerves. When a nerve or group of nerves is stimulated over a period of time, without interruption, by a constant contraction of a muscle or group of muscles, a nervous irritability, due to fatigue, is set up. This proves very detrimental to the whole organism. All of us know the almost unbearable discomfort experienced if the arm is held at shoulder height for even a short period of time. Let us keep this in mind when we come to consider bite-opening dangers.

We have considered the structure and function of the tissues separately. Now let us study their interrelationship in structure and function.

With growth, the permanent teeth are carried upward in the mandible and downward in the maxillae by their own developing alveoli. At the same time, there must be an increase in the length of the rami in order to conform with the increased occlusal development of the maxillary and mandibular teeth. Concurrently, there is an increase in the development of the muscles of mastication which control the mandible, and, as the first and second molars are in the process of eruption, there is a gradual lengthening of the mandible and maxillae in order that they may conform with the development of the muscles.

If anything happens to any of these tissues during the growth process, there will be a modification of the other tissues so that they can all accommodate themselves to one another. No one tissue can exceed the rate of growth of the others. Muscle is the dominant tissue and the others must conform to its rate of growth.

William Colin Mackenzie[1] has written: "It is the length, size and 'tonicity' of the muscle that maintains the normal length and size of the bones and not the reverse as is so often and erroneously taught." This is accepted by most anatomists.

This correlation of growth is synchronized and all parts of the oral cavity are adjusted and adapted to one another through function during the growth process. This does not presuppose perfection of structure. We may have a deformity, but even so the length of the bone to which a muscle is attached is right for that muscle. Whether the temporomandibular joint on the left is identical with that on the right does not alter the predetermined relationship of the tissues. That the dominant muscle, in order to function, must be attached to a bone of the proper length will always be found true. At the completion of growth, the lengths of the muscles of mastication, of the rami, of the alveolus and of the teeth will be compatible with one another. The occlusal surfaces of the posterior teeth approximate, but do not touch each other.

After growth is completed, changes continue to take place, but they are far more gradual and they are not associated

with increase in bulk. There is a gradual breaking down. At first, this is not perceptible but, as senescence approaches, it speeds up. Eventually, if disease or accident does not intervene, the wearing out process outstrips the repair process and death occurs.

The structure of tissues varies in different people as well as in the same person at different periods. In the germ cell, there is a predetermined design for the correlation of all tissues; the temporomandibular joint, and the size and length of the teeth and of the muscles. This is a correlation of structure and function. It goes on throughout life; through the growth period, which is terminated between the eighteenth and twenty-fifth years, through maturity and through senescence. The variability in tissue response during the different periods of life must be kept in mind constantly when we discuss the dangers of bite opening. The tissues of the oral cavity may tolerate something this year and rebel against the same thing next year. But whether resisting or adapting, there is an interrelationship of tissues which cannot be broken. The dangers of bite opening vary greatly and according to the period in which the attempt is made.

The function of the oral cavity is dependent on the action of the nervous system upon the muscles which control the mandible, the only movable bone in the head. This bone is suspended from the base of the skull by the muscles of mastication, the ligaments of the temporomandibular joint and other ligaments. As a result of the action of the muscles as directed by nerve stimuli, the mandible functions in mastication, swallowing and speaking. The alveolar bone is modified by muscular action, only as far as the forces of mastication affect it, indirectly, when the teeth are brought together. The true bone is directly affected by the muscles which are attached to it.

There has been a great deal of discussion in the literature about the changes in the temporomandibular joint. This joint is constructed in such a way that it has a great latitude of movement. It can accommodate itself to any position into which the muscles which control the movement of the mandible are capable of moving it. The form of this joint, the size of the teeth, the length of the muscles and bones and everything associated in the oral cavity develop simultaneously in function. Any effort to change the operation of the temporomandibular joint places a strain on the muscles of mastication and, in order that this be relieved, the adaptable alveolar bone resorbs until the joint is once more in its normal position. Muscle is dominant. It cannot shorten or lengthen and it cannot remain under tension indefinitely. Therefore, the other tissues change and adapt themselves until the muscles are relieved of all strain.

With this background, let us trace the effect on the various tissues of efforts to open the bite. We shall then be in a position to draw conclusions about the dangers of bite opening.

First, we must differentiate between restoring a bite where the normal occlusal relationships of the teeth have been lost as the result of wear or other conditions, and opening a bite when the occlusal relationships of the teeth are functionally normal.

As stated before, the length of the muscles which control the mandible determines the extent to which the posterior teeth erupt. Regardless of the type of bite, there is only a slight space between the occlusal surfaces of the posterior teeth unless some changes in the structures of the oral cavity have taken place as part of the process of growing old. The changes may take the form of wearing of the cusps of the teeth, changes in the alveolus or changes in the bone itself. Any device which restores the normal relationship of the occlusal surfaces of the teeth is in conformity with natural function and is to be commended. But any device

whose object is increasing the distance between the mandible and maxillae would, in so doing, eliminate the natural space between the occlusal surfaces of the teeth. This would place a constant strain on the muscles. The constant pressure exerted by the muscles on the other tissues of the oral cavity would, in time, injure them.

During the developmental period, efforts to open the bite may seem successful because the organism may be able to accommodate the increased bulk between the mandible and maxillae simply as the result of normal development. However, in many mouths in which the bite appears to be closed during the developmental period lie possibilities of development yet to be realized, which will make the bite satisfactory in the adult without any intervention in the nature of bite opening.

Fillings, onlays, inlays, crowns and bridges have their uses in mouths in which teeth have worn down. They may be used to advantage in restoring a bite to normal. Artificial dentures the vertical length of which is not in excess of that of the normal teeth and alveolus are also beneficial in restoring the bite; but this is bite restoring, not bite opening.

Bite restoring opens the bite only to the limit of tolerance of the muscles which govern the mandible. Bite opening presupposes the ability to permanently increase the distance between mandible and maxillae. In order to do this, the muscles which close the jaw would have to be lengthened and, if this were done, a corresponding shortening of the muscles which open the jaw would become necessary. Otherwise, there would be a point at which the mandible would be out of muscular control, as muscles work in groups or pairs. Such a change we know cannot take place. We also know that a change in the rami would be necessary and that this cannot take place. Therefore, when efforts are made to open the bite, the change comes in the tissues which can be changed: in the alveolar bone, the dental periosteum or the true bone of the mandible or maxillae.

I shall take up the dangers of bite opening in two parts; first, in the mouth in which all or most of the teeth are present. In such a mouth, if the vertical length of the teeth is increased beyond normal length by the use of fillings, inlays, onlays, crowns or bridges, the danger is to the alveolar bone, the dental periosteum, the muscles, the teeth and their attachments and the nerves. In the completely edentulous mouth, the danger is only to the muscle, bone and nerve tissue, because the teeth, alveoli and dental periosteum have been lost.

The bite can be opened temporarily by the insertion of onlays, but it will not remain in this position because the muscles of mastication cannot be lengthened. Muscle is always the dominant tissue.

There is only one correct bite for each person. All the measurements, statistics and rules which have been assembled with the object of standardizing the length of the bite are dangerous because, in every individual, the muscles of mastication bear a relation to the other parts of the head which is not duplicated in any other person. For this reason, no amount of analysis of the bite or correlation of data can give us a hard and fast rule for all patients.

Statistics cannot be used to determine the ideal bite for all individuals. It seems that many practitioners, in making a restoration, try, by some mechanical means, to improve the bite without giving due consideration to the effect that the change will have on all correlated tissues. They disregard the damage which may be done to the muscles, nerves, bones, alveolar process and dental periosteum.

I do not look at this solely from a scientific standpoint. I have many clinical examples of the disastrous results of efforts to open the bite. Following are a few cases:

A young Spanish girl was brought to me recently for consultation. An attempt

had been made to open the bite for the purpose of improving her appearance. Onlays had been placed on the lower first permanent molars. The patient had tolerated the discomfort for some months, but eventually had the onlays removed. Several months had elapsed since their removal. The molar teeth were perceptibly below the occlusal surface of the other mandibular teeth. They had been depressed to the extent of the thickness of the gold which had been applied to their occlusal surfaces. Resourceful nature had relieved the situation. The alveolar bone of the mandible had begun to resorb and would probably have continued to do so until the space between the occlusal surfaces of the molar teeth had become sufficient to permit the complete relaxation of the muscles controlling the mandible. The muscles cannot lengthen nor will they tolerate a permanent strain. Therefore, the other tissues adapt themselves. Either the alveolar bone or the roots of the teeth are resorbed.

Another case was that of a woman of 50. Apparently, wear of the occlusal surfaces of the posterior teeth had caused the anterior teeth in the mandible to strike against the lingual surface of the maxillary anterior teeth. The prosthodontist, in undertaking to relieve this condition, had placed onlays on the posterior teeth for the purpose of raising the bite, but he had overdone it. The occlusal surfaces of the posterior teeth were in contact at all times and, in consequence, the muscles were always under tension. The normal space between the occlusal surfaces of the teeth had been eliminated and, as a result, the muscles were never completely at rest. The resultant strain was similar to that referred to in describing the discomfort experienced when the arm is held at shoulder height for even a short time.

My experience in general practice showed me conclusively the futility of inserting high artificial teeth in order to open the bite. A patient came to me for partial dentures. Three mandibular posterior teeth had been lost on the left and right sides. The sharp edges of the mandibular teeth cut the tongue and the mouth closed so far that the mandibular teeth could not be seen.

In supplying bridges, I made an effort to open the bite. The posterior replaced teeth were so high that, when the mouth was closed, the mandibular anterior teeth barely touched the maxillary anterior teeth. The result appeared desirable, but it was short-lived. The bite soon reverted to the former position, and although I repeated the procedure, no lasting result could be obtained. Either the pull of the muscles caused the teeth which supported the bridge to be depressed or else the roots of the teeth were resorbed. The anterior teeth were in exactly the same relation to the lip as they had always been. This ruled out the possibility that they had elongated. I realized that I was beaten, but the reason did not occur to me until I became better acquainted with the tissues of the oral cavity.

Many of my professional friends have discussed with me the indescribable discomfort of which patients complain when artificial dentures are placed. In almost every case, if the teeth are shortened by grinding, the patient can be made comfortable because the muscles can relax again.

Having pointed out the reasons that a bite cannot be opened, let us consider the ill effects of an effort to open it.

Most of the ill effects are due to trauma. The trauma is caused by the excessive pull of the muscles. This excessive pull is caused by the increase in bulk between mandible and maxillae which is used in trying to open the bite.

In the mouth in which most of the teeth are present and the bite has been opened by the use of onlays or some other mechanism, the constant trauma may gradually break the fibers of the dental periosteum and, with this support cur-

tailed, the teeth tip, rotate and loosen. The gingiva fails to hug the necks of the teeth, and pockets may develop and infection result. The alveolar bone may be resorbed until the pressure is relieved or the roots of the teeth may be resorbed. Much harm may be done and, in many cases, the teeth are eventually lost.

In the case of artificial dentures which have been made too high in an effort to open the bite, the harm is only to the true bone, the muscular tissue and the nervous tissue, the alveolar process, dental periosteum and teeth having been lost.

If the patient perseveres in wearing the overly high denture until the nerve reaction has passed, the true bone of the mandible or maxillae or both will probably have been resorbed to the extent necessary to relieve the muscular tension.

In both the completely and the partially edentulous mouth, there is usually a severe nervous upset following bite opening efforts, and this, to me, is one of the most serious dangers of bite opening. It varies from an occasional complaint to near nervous collapse, depending on the degree of nervous irritability of the patient.

We must remember that the brain not only sends impulses to the muscles: it receives impulses from the muscles as well. The tissues of the oral cavity are interrelated in structure, development and function. Let any part of this normal relationship be upset and the brain receives a message which varies from mild discomfort to acute pain. This discomfort sets up a nervous irritability in turn, which has a detrimental effect on every part of the body. Some patients unwisely persevere too long in their efforts to become accustomed to the discomfort. Fortunately, most people insist upon early grinding in order that the discomfort may be relieved. In this way, some of the damage which might otherwise have occurred is prevented. Some dentists remake dentures for patients when they complain of discomfort. They might save themselves trouble and the patient pain if they ground the teeth to the normal height without delay.

There is one danger about which you probably did not expect me to speak: the danger of fooling oneself. Some men have gone so far as to assert that they can relieve deafness by opening the bite. I should like to refer them to an article by Oscar V. Batson.[2]

Our teaching and our textbooks have conspired to confuse men. They have led men to believe that bites can be opened, and most men have lacked the intellectual curiosity and the energy required in order to analyze the problem and learn the truth. We, all too often, drift along, never bothering to think a problem through, and then wonder at the disappointments and regrets which come to us and to our patients.

It is the same carelessness, coupled with false optimism, which has allowed that misleading word "permanent" to gain such a stronghold in the thought and language of dentistry. The term is used indiscriminately and without thought. Men speak of the permanent set of teeth, permanent bridges, permanent fillings, etc. We all know there are no such things. We speak of permanent structures, but we know that no tissue of the body is absolutely permanent. We speak as though dental work, once done, would never have to be replaced or repaired. I hope I have been able to show how very *impermanent* bite opening is.

Many men are carried away by their desire to render a service to their patients. They forget that although medicine has gone far, and man, in his development, has also progressed, neither the professions nor human development has reached a stage of perfection. There are still many things that we should like to accomplish, but cannot in the light of present knowledge.

What a step forward it will be when

the profession, as a whole, realizes that the greatest service that we can render a patient is to refrain from undertaking and promising the impossible. Let us recognize the fact that the structure and function of the oral cavity impose limits upon us which we cannot exceed without doing harm. Failure to do this is back of all the dangers of bite opening.

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MALIGNANT DISEASES OF THE MOUTH

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MALIGNANT diseases of the mouth, if the patients are properly treated in a reasonably early stage, offer a good prognosis in a high percentage of cases. In spite of this fact, however, oral malignancy accounts for approximately 30 per cent of deaths attributable to cancer. The marked discrepancy in these statements emphasizes the need for further education of the public to an appreciation of the malignant possibilities of various oral lesions and the necessity of early consultation; also, of increased diagnostic acumen on the part of the dentist and physician and earlier and more effective therapeutic measures in these cases. Recognition and proper treatment of premalignant and early malignant lesions of the buccal cavity will go a long way toward reducing the mortality in this condition, and the best efforts of dentists and physicians should be directed to this end.

Malignant tumors of the mouth, as of other parts of the body, may occur at any period of life, but are much more frequently encountered after the age of 40 years. Males are more often affected than females; the ratio being about eight or ten males to one female. In cancer of the lower lip, the disproportion is even greater than this. The lower lip is the most common site of origin of malignant disease of the mouth. Cancer develops in this situation between three and four times as often as it does on the tongue and more than five times as often as it develops in the remainder of the oral mucous membrane.

Squamous cell epitheliomas comprise the great majority of malignant lesions of the mouth. Adenocarcinomas of mixed tumor type, adamantinomas and various forms of sarcoma occur much less frequently. Lymphosarcomas, which are commonly found in the pharynx, are rarely seen in the mouth. Squamous cell epitheliomas vary greatly in activity, ranging from inactive papillary growths to fulminating, sarcoma-like neoplasms. Broders' method of grading malignant tumors according to their activity as evidenced by cellular differentiation and formation of keratin is of inestimable value in determining the type of treatment advisable in these cases. It should be borne in mind, however, that the grade of a malignant tumor is not an index of its radiosensitivity.

Certain local conditions at times ap-

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pear to have a definite etiologic bearing on the development of cancer of the oral cavity and to influence directly the degree of malignancy and the prognosis. Dental sepsis is commonly associated with cancer and is often extreme. Carcinoma of the mouth often develops adjacent to carious teeth and ill-fitting dentures. On the other hand, such growths are encountered in examination of edentulous persons only infrequently and, when they do occur, are almost always of an inactive type. The much greater frequency of the disease among males as compared with females is striking. It is of course a fact that chronic irritation is more often present in the mouths of men. The possible relationship of the use of tobacco to the development of oral carcinoma is still disputed. Many of our patients with such growths have been heavy smokers. Moreover, on a number of occasions, I have observed that the part of the inner surface of the cheek against which a patient had for years carried a quid of tobacco was covered with a thickened, leukoplakial lining and, in several instances, epithelioma had developed in this. Cancer of the lip often arises in an inflammatory or other benign lesion. Epitheliomas inside the mouth frequently originate in areas of leukoplakia, particularly of syphilitic and papillary type, and chronic thrush may be a forerunner of epithelioma. Syphilis is present in from 40 to 50 per cent of cases of cancer of the tongue.

Symptoms of malignant disease of the mouth usually become manifest early, although they may not attract the patient's attention until the lesion is practically inoperable. The time of their appearance and their severity depend largely on the situation of the growth and on the amount of infection present. Discomfort or severe pain frequently follows discovery of the tumor in the mouth, but may precede it. In cases in which highly malignant growths are situated well posteriorly on the tongue or in the floor of the mouth, the presence of a metastatic mass in the neck, noticed by the patient as a painless lump, may be the first intimation of trouble.

Cancerous growths of the oral cavity vary greatly in appearance. Nevertheless, they are sufficiently characteristic to permit of clinical recognition in a high percentage of cases. These tumors may be present as papillary, smooth, glistening, nodular, elevated or ulcerated lesions. As a rule, there is induration of the base and the tumor may be almost cartilaginous. Prominent blood vessels usually stand out on the surface and especially about the margins of the growth. Ulceration commonly takes place early. As it progresses, the pain increases, becoming continuous, and the foul, fetid odor characteristic of oral malignancy is noted. With this, there is increased secretion of mucus, which is attributable to local pain and irritation together with progressive dysphagia. Metastasis of such tumors into the regional lymphatic structures is prone to occur rather early in the course of the disease. The rapidity and extent of spread vary with the activity, vascularity and situation of the growth, the severity of trauma to which it may be subjected and the degree of inflammatory reaction and infection present.

Early diagnosis is essential if treatment is to be effective. Difficulty in diagnosis is likely to be encountered if treatment has been given recently because of the resultant inflammatory reaction and the change in the appearance of the growth. Recent treatment often will interfere also with microscopic recognition of these lesions. Whenever the clinical findings do not permit of a positive diagnosis, a biopsy should be made. This is best delayed, however, until one is prepared to proceed with any indicated therapy.

A number of benign conditions must be distinguished from oral carcinoma. Among the most important of these are the primary sore of syphilis and the gumma of tertiary syphilis. Simple,

chronic, inflammatory ulcers, tuberculosis and blastomycosis must be considered. At the clinic, we have encountered a number of cases in which primary actinomycosis of the tongue has been mistaken for cancer. Hypertrophic lesions in the buccal folds attributable to ill-fitting dentures and infected angiomas are likewise confusing, and observation for from a week to ten days, or even longer, may be necessary for differential diagnosis. One of the most troublesome problems is presented when syphilis and carcinoma coexist, particularly in the tongue, which is not unusual. Frequently, antisyphilitic measures, instituted in such cases because of positive results of serologic tests, will be followed by marked improvement for a time. This early, favorable response often results in continuance of the treatment in spite of further activity of the lesion, and the malignant growth may actually become hopelessly inoperable before the true nature of the lesion is recognized.

Malignant tumors arising in any given situation within the mouth tend to conform to a certain histologic type and degree of activity and their response to therapeutic measures is similar. These growths are therefore best considered according to their site of origin.

LESIONS OF THE LIPS

Malignant tumors of the lips include squamous cell epithelioma, basal cell epithelioma and adenocarcinoma of mixed tumor type. The great majority are squamous cell epitheliomas and, with few exceptions, these arise on the vermilion border of the lower lip. Basal cell epitheliomas at times develop on the cutaneous surface of the upper lip and may involve the vermilion border secondarily. Adenocarcinoma, which is rare in this situation, may arise within the body of either the upper or the lower lip. Only about 1 per cent of patients with malignant tumors of the lower lip are females. While cancer of the lip is most frequently encountered in examination of persons who are past middle age, on several occasions I have encountered it in the second decade of life. Our youngest patient with this condition was a boy 13 years of age. The growths are usually single, but may be multiple. They commonly originate in simple ulcers, fissures, scars, areas of leukoplakia and keratotic and other benign lesions, although some of them are undoubtedly malignant from their inception. The majority of cancers of the lip are of low grade or moderate activity, more than three-fourths of them being of malignancy grade 1 or 2. Approximately an eighth are rather highly malignant and a small percentage are fulminating in type. Their duration at the time of the patient's coming under observation may range up to several years in spite of the prominent situation of the lesion. In approximately half of the cases encountered in the clinic, active treatment had been carried out previously. This fact is of considerable importance, for the response to treatment is less favorable and metastasis is more likely to occur with recurring than with primary lesions.

The size of these lesions of the lip at the time treatment is sought varies greatly. Frequently, they are only a few millimeters in diameter. However, they may range up to 5 or even 10 cm. and may involve the entire lower lip, chin, a portion of the cheeks and the upper lip as well. There may be fixation to and erosion of the mandible, and at times the growth extends directly through the mental foramen and along the inferior dental canal. Metastasis into the regional lymphatic structures is encountered in a varying percentage of cases, depending on the extent and activity of the lesion and whether treatment has been given previously. The involved nodes may be fixed to the mandible or the deep structures of the neck and may be broken down.

Cancer is prone to develop in any

chronic lesion of the lower lip, and the presence of thickening or ulceration in this situation for more than a few weeks, if a man is past 40 years of age, must be viewed with suspicion. Treatment of these lesions should never be carried out until every effort has been made to establish a diagnosis. The common practice of applying silver nitrate or other caustic substances, radium, roentgen rays or the actual cautery, to such lesions often leads to trouble later. In the absence of a diagnosis, such treatment is usually incomplete and, if the lesion is malignant, stimulation of the growth, with increased possibility of metastasis, often results. If there is induration of the border of the lesion, the diagnosis may be evident on clinical examination alone. In approximately half of the cases, however, only microscopic study will lead to positive recognition. I prefer to remove such lesions by excising an elliptical portion extending along the vermilion border. This is readily done under local anesthesia and leaves no noticeable deformity. If microscopic study shows the lesion to be actively malignant, the regional lymphatic structures are removed.

When the lesion on the lip appears definitely epitheliomatous on clinical examination, removal by excising a v-shaped piece of tissue is carried out, unless the patient's age or general condition definitely contraindicates this. The risk associated with removal of the primary lesion together with the regional lymphatic structures is comparatively slight. Provided there is no attachment to the mandible and the lesion of the lip is of a low grade of malignancy, immediate plastic reconstruction is indicated even though the extent of the growth has necessitated removal of the entire lower lip. By means of tissue brought in from the cheeks, an excellent cosmetic and functional result may be obtained. When the cancer is active and involves the cheeks or is attached to the mandible, wide excision with the cautery knife or destruction by electrocoagulation, leaving the wound wide open, is advisable. Thorough cauterization of the surface of the mandible over the place of attachment is necessary in such cases, and plastic reconstruction of the lip must be delayed until the patient has been free from evidence of the disease for at least nine months, the time depending on the extent and activity of the growth. A lined flap from the forehead, a triangular flap from the upper lip or a tubed flap from the thorax can then be utilized. Removal of the submental and submaxillary lymph nodes, when indicated, is usually carried out at an operation subsequent to the one in which the primary growth is removed, unless there has been clinical evidence of involvement of the lymph nodes, in which event dissection usually precedes treatment of the primary growth.

Results.—In a series of 942 cases of cancer of the lower lip in which treatment was carried out at The Mayo Clinic during a period of ten years, recurrence took place either locally or in the lymph nodes almost four and one-half times as often when treatment had been given previously as when there had been no previous treatment. Approximately 90 per cent of the patients who were without involved lymph nodes remained well for five years or more.

LESIONS OF THE CHEEKS

Most of the malignant growths originating on the inner surface of the cheeks are squamous cell epitheliomas. They are similar in clinical behavior and in degree of malignancy to those of the lower lip, although the lesions of the cheeks tend to be slightly more active. They most frequently develop on a line opposite the occlusal surfaces of the teeth, since these regions are subjected to greatest trauma. The amount of trauma and irritation to which malignant growths of

the cheeks are subjected by the teeth or by other agents often determines their rate of progression. Lesions arising in the commissure between the upper and the lower lips are prone to metastasize early, owing to the alternate stretching and compression incident to movement of the jaws. It is interesting to note in this connection that increased clinical activity of malignant neoplasms attributable to acute infection and inflammation is frequently seen, without corresponding increase in histologic activity of the lesion. Epitheliomas of the inner buccal surfaces tend to extend promptly to involve the jaws and, if extension is not controlled, perforation of the cheek occurs.

The treatment of malignant tumors of the cheeks is much the same as of cancer elsewhere inside the mouth. When well localized, the lesions may be excised sharply or with the cutting diathermy electrode. While the wound is at times sutured, more frequently it is cauterized and left open. More extensive growths, and especially those involving the jaws, are subjected to wide electrocoagulation. This procedure, supplemented with implantation of radium or radon points, if deemed advisable, is highly preferable to excision and offers a better prognosis. The indications for dissection of lymph nodes are the same in this group of lesions as in cases of cancer of the lip. However, it is necessary to remove the lymphatic structures only on the side of the primary lesion in the usual case, for unless incomplete treatment has been carried out previously, or the growth has been acutely inflamed, extension into the lymphatic structures on the opposite side is not likely to occur. Metastasis to the cervical nodes on the side of the lesion occurs most commonly. The removal of extensive neoplasms from the inner surface of the cheeks is likely to be followed by a varying degree of ankylosis. This may be complete when the scarring obliterates the buccal folds. Sacrifice of the full thickness of the cheek, with resultant perforation, is unavoidable when the growth is attached to or infiltrates the overlying skin. Repair of such a defect should be delayed for from six months to a year, the time depending on the extent and activity of the growth.

LESIONS OF THE TONGUE AND FLOOR OF THE MOUTH

Generally speaking, malignant lesions of the tongue and floor of the mouth are the most formidable of all those which occur within the oral cavity. As a group, they are more highly malignant than those which arise on the lips, cheeks or alveolar processes. Accordingly, they are prone to metastasize more promptly. The extreme vascularity of the tongue, and its rich lymphatic supply, are important factors in this regard. Radium therapy supplementing surgical measures has definitely improved the prognosis in this group of cases, but further improvement probably will result only through early recognition and proper treatment of premalignant lesions and early cancerous growths.

The most common malignant tumor of the body of the tongue is the squamous cell epithelioma. Hemangio-endotheliomas and adenocarcinomas of mixed tumor type occasionally are encountered; also lymphosarcomas. The last named type of growth, however, is much more frequent on the base of the tongue. Approximately 90 per cent of the victims of cancer of the tongue are males. Most of the patients are between 45 and 60 years of age, although the condition may occur considerably earlier in life.

Cancer of the tongue is as a rule readily recognized grossly unless the clinical picture has been changed by an acute inflammatory process or recent therapy. A number of benign conditions must be excluded. Among these are gumma, the thickened lesion of leukoplakia, the benign papillary lesion, infected cyst,

fibroma, solitary tuberculoma, actinomycosis and blastomycosis. Acutely inflamed angiomas, especially lymphangiomas, at times strongly resemble malignant neoplasms in this situation. An enlarged circumvallate papilla and the normal accumulation of lymphoid tissue at the juncture of the lingual border and anterior tonsillar pillar frequently have been mistaken for carcinoma. Biopsy should be carried out promptly when a definite diagnosis cannot be established otherwise.

Cancer of the tongue most frequently involves the lateral borders, as one might well expect since these regions are likely to be subjected to greatest trauma. From the standpoint of prognosis, the most favorable site of involvement is the tip of the tongue. The most unfavorable site is the lingual base, since it is difficult to determine definitely the extent of involvement, and the lesions are less accessible than those elsewhere and are highly malignant. Growths on the ventral aspect of the tongue and floor of the mouth offer a less satisfactory outlook than those on the dorsum and about the borders because of the tendency to rapid local extension and metastasis. Lingual carcinoma allowed to progress without treatment usually will cause death in approximately a year.

The treatment advisable in a given case will depend on the extent, activity and situation of the growth. Well-localized tumors on the anterior portion of the tongue may be excised sharply, or with the cutting cautery, particularly if they are not highly malignant. Those situated further posteriorly, as well as those on the ventral aspect, and involving the floor of the mouth, are more satisfactorily destroyed by diathermy and implantation of radium in the region of coagulation. Lesions too extensive for surgical removal should be treated with implanted radium. The use of gold radon points is most satisfactory in this group of cases and frequently gives surprising results. Removal of the regional lymphatic structures should be carried out in surgical cases. The nodes most frequently involved are one anterior to the internal jugular vein, below the submaxillary group of nodes, and one in the deep cervical group, just posterior to the submaxillary group. These are frequently involved even though they are not palpable.

Of a group of 162 patients treated in The Mayo Clinic for cancer of the tongue, 156 were traced, and 37.2 per cent of these were found to be living five years or more after operation.

LESIONS OF THE JAWS AND PALATE

The jaws and palate may be the site of a number of different types of malignant tumors, which may develop in the bone itself, the soft tissues investing it or the dental structures. In addition, various types of active neoplasms at times originate within the antrum and involve the palate and upper jaw secondarily. The malignant growths encountered in these regions include epithelioma, adenocarcinoma, adamantinoma and various forms of sarcoma. Squamous cell epitheliomas are by far the most common. Mixed tumors occur in the palate from time to time, while adamantinomas are most often found in the posterior portion of the mandible. Generally speaking, carcinomas of the jaws are of a low grade of malignancy or of moderate activity, and they do not, as a rule, metastasize until they have involved the adjacent soft tissues of the cheeks, lips or floor of the mouth. Highly malignant, sarcoma-like epitheliomas graded 4 according to the scale of Broders do at times develop on the alveolar processes, but they are of infrequent occurrence. Melano-epitheliomas constitute a rare form of carcinoma seen in this situation. They usually arise from the palate and, like cutaneous tumors of this type, are highly

malignant. They vary in color from a dirty gray to almost coal black and at times are pedunculated. Dark, pigmented streaks may extend widely into the surrounding tissues, well beyond the apparent limits of the neoplasm. Tissue removed from such tumors at times strikingly resembles material from an old hematoma.

Carcinoma of the jaw usually can be diagnosed readily from the clinical examination alone, by one who has had an appreciable experience with such tumors. Biopsy is not likely to be necessary unless there has been recent treatment or the growth has been traumatized. However, it is advisable to take a specimen for microscopic confirmation in all cases, before instituting treatment, both as a matter of record and to avoid possible confusion. It is not unusual to encounter cases in which a carcinoma of the jaw has become hopelessly inoperable owing to gross mismanagement. Frequently, this has been the direct result of failure to make histopathologic studies in the early stage of the disease. It is, indeed, surprising to observe the advanced stage to which malignant disease of the jaws at times progresses without its true nature being suspected either by the patient or by his physician or dentist.

Epithelioma of the jaws is better treated by surgical diathermy or the actual cautery than by resection. For lesions of a low grade of malignancy, surgical measures are relied on almost entirely. For highly malignant growths, on the other hand, irradiation is always used to supplement surgical procedures. The more common types of sarcoma in these situations are the osteogenic and fibrous forms. These tumors are usually more highly malignant than the carcinomas which develop about the jaws and they are more difficult to control. They are also much less frequently encountered. Although there is rapid local growth, ulceration does not occur so early as in epithelial tumors. Extensive metastasis may take place early in the course of the disease. The diagnosis of sarcoma of the jaw may be strongly suggested by the rapid growth and by the smooth, vascular mass, free of ulceration; but, in view of the infrequency of such tumors as compared with carcinomas, a positive diagnosis scarcely would be justified in the majority of cases without biopsy. Only in cases of osteogenic sarcoma is the roentgenogram sufficiently characteristic to be diagnostic. Irradiation is the treatment of choice for this group of tumors, although the response to treatment varies greatly.

Adenocarcinomas of mixed tumor type may originate in either the hard or the soft palate or in the pharyngeal walls. These neoplasms differ from all the other malignant tumors originating in the soft tissues of the mouth in that they are encapsulated, grow very slowly and, as a rule, do not metastasize until late in the course of the disease. Although some authors prefer to classify them with the benign tumors, there appears to be little justification for this, for once they have broken through their capsules, either spontaneously or on trauma, they may infiltrate the surrounding tissues and metastasize quite as actively and widely as malignant lesions of other types. Clinically, they are firm, smooth or slightly nodular, discrete, somewhat elongated, rounded masses covered by normal mucous membrane. The tumor may not be of uniform consistency throughout, both cystic and cartilaginous portions often being present. As a rule, they do not ulcerate spontaneously. Occurring on the hard palate, they produce by pressure absorption a smooth concavity in the bone and may perforate the palate. They are usually easily recognized on clinical examination and, with careful dissection, can be removed with the capsule intact; in which event, the prognosis is good. If they are incompletely removed, they recur, grow-

ing more rapidly and possibly metastasizing.

The adamantinomas or adamantine epitheliomas are multilocular, cystic tumors belonging to the group of cystic ondontomas. Although they occur most frequently in the jaws, they may also develop at the base of the skull in connection with the pituitary gland and even elsewhere in the body. Occurring in the jaws, they are much more common in the mandible than in the maxillae and usually are found in the region of the angle, adjacent to the third molar tooth. They apparently originate from certain cells of the enamel organ, from which their name is derived. The tumor is found chiefly in examination of adults between the ages of 20 and 40 years, although it has been observed during the first decade of life and as late as the seventh. It is more often seen in females than in males. It is commonly situated deep in the body of the mandible. The tumors vary greatly in size at the time of the primary examination. At times, they are only 2 or 3 cm. in diameter. Again, they are of huge proportions, as large as a grapefruit or even larger. They are partly cellular and partly cystic in varying proportions, the cellular and cystic areas being separated by bony trabeculae so that, on palpation, they often present an irregularly honeycombed surface, which is highly suggestive from a diagnostic standpoint. The roentgenogram, for the same reasons, is sufficiently characteristic to permit of positive diagnosis in a high percentage of cases. In rare instances, a tumor of this type presents a single large cystic cavity. These neoplasms are mildly malignant, being of about the same grade of malignancy as the basal cell epithelioma. Although metastasis is unusual, it does occur in rare instances. Death is not infrequently caused by direct invasion of the skull by these tumors.

The tendency among surgeons in the past has been to deal entirely too conservatively with these tumors. However, in recent years, there has been a marked swing back toward the radical treatment of some years ago, and it is to be anticipated that fewer recurrences of these growths will be encountered in the future. Electrocoagulation, in our hands, has proved most effective in dealing with tumors of this group.

CONCLUSION

Clinical, diagnostic, prognostic and therapeutic study of malignant diseases of the mouth gives convincing evidence that the mortality in such cases is unduly high and that more careful consideration of diagnosis and treatment when these lesions are in the early stages will greatly improve the end-results.

THE ORGANISMS IN VINCENT'S INFECTION

By Ruth Tunnicliff, M.D., Chicago, Ill.

THE term Vincent's, or fusospirochetal or fusospirillary, infection is applied to a disease affecting chiefly mucous surfaces and characterized by necrosis, pseudomembrane formation and a putrid odor. Stained smear preparations from such lesions, show a characteristic bacteriologic picture consisting of fusiform or spindle-shaped bacilli and less distinctly stained, loosely wavy spiral forms. The bacilli, which vary in length, are generally slender with pointed or slightly rounded ends, and are straight or slightly curved. The bacilli are usually scattered uniformly throughout the preparation and may occur in pairs, end-to-end, and often contain granules or bands. They are gram-negative and are generally described as non-motile.

The spiral organisms generally spoken of as spirochetes are long and delicate and present three or four irregular loose turns. They do not stain by Gram's method and are more quickly decolorized than the bacilli. They are usually actively motile, but sometimes not.

Both bacilli and spirilla stain readily with carbol-gentian violet and carbol-fuchsin. A satisfactory method consists of staining a thinly spread smear fixed by heat with carbol-gentian violet for a few seconds, washing and covering with Gram's iodine solution for a few seconds, washing and drying. The organisms stain a purple black and are very distinct.

In the early stages of the infection, these organisms are most abundant. The bacilli appear before the spiral organisms. Both decrease as the process of recovery advances. When the bacilli and spiral forms are most numerous, other forms of bacteria are present in small numbers. The associated bacteria usually increase as the fusiform bacilli and spirilla decrease. Polymorphonuclear leukocytes are usually present in the acute infection.

The fusiform bacillus is an anaerobe and may or may not produce a fetid odor in cultures. Some body fluid, such as blood or ascitic fluid, is generally necessary for their growth, but Slanetz and Rettger[1] have used effectively a medium of potato extract-agar to which 1 :20,000 gentian violet is added to prevent the growth of other bacteria. The fusiform bacillus appears to be very resistant to gentian violet.

Although several spirochetes from the mouth have been isolated in pure culture, the spiral organism associated with the fusiform bacillus in Vincent's infection so far has apparently not been isolated in pure culture. The spiral forms seen in pure cultures of the fusiform bacillus resemble those in the lesion and will be described later.

The strongest evidence[2, 3, 4] of an etiologic relation between fusiform bacilli and the associated spiral organism and the necrotic processes with which they are associated is furnished by their presence, unmixed with other bacteria, in the area of advancing necrosis. Most observers agree that the exudate on the surface of the lesion contains fusiform

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bacilli, spirilla mixed with cocci and other bacteria and that necrosis occurs only after the tissue is invaded by the bacillus. Between the necrotic and the living tissue, there is an area containing enormous numbers of spiral organisms and fusiform bacilli in palisade arrangement. The bacilli and spirilla alone invade the living tissue, the spiral forms definitely in advance of the bacillus, and are here more numerous than the bacilli. Sections stained by the Gram-Weigert method show cocci in the exudate and the external layer of the tissues, but not associated with the fusiform bacilli and spiral forms near and in the living tissue. The histologic appearance of the tissues depends on the amount of cellular reaction of the living tissue. The less marked the reaction, the more extensive the invasion of the organisms. The inflammation is generally fibrinous and shows a variable number of polymorphonuclear leukocytes and proliferation of connective tissue cells. According to Stewart, fatal cases show practically no reaction locally, no proliferation of fixed tissue cells and only an occasional polymorphonuclear cell. The fact that immunity tests (phagocytic) on patients with ulceromembranous infections show definite reactions to cultures of the fusiform bacillus also suggests their pathologic significance.

When fusiform bacilli and spirilla occasionally invade the tissue in pyorrhea, the bacilli are very few in number; while the spirilla are more numerous than in ulceromembranous lesions. The presence of large numbers of spirilla in the tissue in pyorrhea is possibly due to the fact that the infection is chronic. They are found in the tissue only in severe pyorrhea.

The question whether fusiform bacilli and the spiral forms with which they are nearly always associated in apparently normal as well as in pathologic conditions are separate organisms or parts of the life cycle of one has long been a subject of discussion. The earlier workers, who reached the conclusion that the two organisms were different forms of one, studied either sections of tissues or mixed cultures. The pure cultures of these bacilli which were first isolated showed no spiral forms. Later, several observers found spiral organisms in their pure cultures of fusiform bacilli and concluded that the two organisms were different forms of one. Opposing this theory is the fact that, although the spirillum-like forms in cultures could not be distinguished morphologically from the motile spirilla in the original material, those in cultures were not motile. This is true, but motility cannot always be demonstrated in the spiral organisms in the original material, and pure cultures of spirochetes are sometimes immobile. Moreover, it is often difficult to demonstrate motion in bacteria known to be motile. Some discredit the theory that the bacillus and the spirillum are different forms of one organism because one form is motile and the other is not. There is a difference of opinion about the motility of the bacillus. However, there is a form of bacteria, Nitrosomonas, which grows as a non-motile mass and later resolves itself into motile cells.

Fusiform bacilli are believed to develop not into true spirochetes, but into loosely coiled spiral forms resembling spirochetes.

The simplest explanation of the spiral forms in pure cultures of fusiform bacilli is that they are dissociants[5, 6] of the bacillus and are found in the rough colonies. The bacillary forms are associated with the smooth colony. This change in form of bacteria in rough colonies when changed from smooth is now a common observation. The phenomenon of dissociation may explain some of the differences in size and form of the bacillus, in colony formation and in biochemical, fermentation and immunity reactions in the various strains of fusiform bacilli studied. Like other bacteria, strains of fusiform bacilli differ in the ease

with which their form can be changed.

Fusiform bacilli have been divided into various groups according to morphology and biochemical, sugar and immunity reactions. Pesch and Schmitz,[7] after studying 193 pure cultures, concluded that although the bacilli could be classified into groups, there were not different kinds of fusiform bacilli, but one single "Fusiformes Bacterium." Sanarelli[10] has changed an intestinal "spirochete" isolated from guinea-pigs into a fusiform bacillus. Here, the fusiform bacillus was probably a dissociant of a "spirochete."

There is a difference of opinion as to the importance of fusiform bacilli and spirilla, on account of their presence in the apparently normal mouth and in lesions other than ulceromembranous and our inability to reproduce the lesions except with mixed cultures or a mixture of bacteria. They are looked on by some as of no pathologic significance. There is, however, considerable evidence that these organisms become pathogenic when the vitality of the tissue becomes impaired.

Resistance of the patient is probably of greater importance than the infectivity of the organisms. These organisms are anaerobes and they grow readily in crevices and diseased tissues. They may be present around the gingiva and in tonsillar crypts without resultant ulceration. Considered among the predisposing factors in the development of the ulceromembranous lesions are local irritants and infection, drugs, dietary deficiency disease (specific vitamin deficiency), leukopenia and debilitating disease. Predisposing factors, however, cannot always be found in these ulceromembranous infections.

Experimental evidence that lowered tissue vitality is essential for the pathogenic action of these organisms is furnished by the experiments of Wallace, Wallace and Robertson[8] and those of Miller and Rhoads.[9] The former observed that fusospirillary infections developed in the mouths of dogs after the intravenous injection of scillaren B. Miller and Rhoads reported ulcerative stomatitis in dogs following a diet causing black tongue. These lesions generally showed spiral organisms and fusiform bacilli.

The observations of Wallace, Wallace and Robertson are especially valuable in showing the different stages in the formation of the lesion. Typical smears from fusospirillary infection were not seen in the dog until necrosis occurred. During the first three days, all the fusiform bacilli were small, the large typical "cigar" shaped fusiform bacilli becoming numerous about the sixth day, when the spiral forms appeared and necrosis became evident. The acute infection was accompanied by a high leukocyte count. Although fusiform bacilli and spirilla were normally present in the mouths of dogs, no fusospirillary infection developed until scillaren B was injected. Another interesting observation was that the infection was not contagious; which is in accord with the view of many concerning the human disease.

D. T. Smith[10] has produced experimental noma by injecting material from the mouth of a patient with pyorrhea into the cheek of guinea-pigs on a scorbutic diet. All of these guinea-pigs died. Eight of ten normal animals similarly inoculated developed only local abscesses and all but two recovered.

Although typical fusospirillary lesions have not been produced with pure cultures of fusiform bacilli, abscesses in the skin or peritoneal cavity of lower animals, with ulceration in one instance, have been observed[11, 12] on injection of nonvirulent strains after preparation of the area to be injected with scillaren B or suspension of the organisms in mucin. Injection of scillaren B produced leukopenia and dilated the blood vessels. Although the cultures injected showed only bacillary forms, spirilla-like organisms were demonstrated in smears and sections

of the abscesses. In one rabbit injected with scillaren B, the abscess in the skin ulcerated four days after the injection of fusiform bacilli. The pus near the surface was thick and contained poorly stained fusiform bacilli, polymorphonuclear leukocytes and many endothelial cells. Pus deep in the abscess removed with a sterile pipet showed a few short, rather thick fusiform bacilli and many spirilla-like organisms, some in clumps. The spiral organisms were of two types, slightly wavy, with irregular curves and more tightly coiled forms resembling spirochetes.

These experiments show that lesions containing both fusiform bacilli and spirilla-like forms can be produced by injections of a pure culture containing only bacilli, provided the resistance of the animal is lowered, and thus further evidence is furnished that the bacilli and spirilla represent different stages in the development of one organism. They also demonstrate that while the change from the bacillary to the spirillary form may be slow in cultures, the change is rapid in tissues.

The classical picture of fusiform bacilli and loosely wavy spiral organisms in smears from acute ulceromembranous lesions (Vincent's infection) in the mouth is comparatively clear. If this infection, however, occurs in a mouth showing gingivitis, soft calculus, badly diseased teeth, pyorrhea or tonsillar granules, the picture is very confusing on account of the presence in these conditions of different types of fusiform organisms and enormous numbers of various kinds of spirochetes, the significance of which is not known. All of these spirochetes and different types of fusiform organisms are anaerobes growing under the same conditions, and it is impossible, from a smear preparation containing a mixture of these organisms, to differentiate the fusiform bacillus which is associated with an acute Vincent's infection. In smears from the mouth, fusiform organisms more or less resembling each other and indiscriminately described as fusiform bacilli are found to be distinct organisms when isolated in pure or even in mixed cultures. Among cultivated anaerobic organisms generally confused with fusiform bacilli are *Spirillum sputigenum,* comma-shaped with pointed ends and motile; the motile bacillus producing rosettes and test-tube brushlike forms found in tonsillar granules and soft calculus; a large motile single or double, slightly curved organism, and a short spindle-shaped bacillus growing in chains.

Unfortunately, the diagnosis of Vincent's infection is often made on the observation of large numbers of spiral organisms and almost any large deeply staining bacillary form. In making a diagnosis, one must keep in mind the typical picture seen in the unmixed infection and must be guided by the clinical findings. This is especially necessary in lesions around the gingivae where a diagnosis from smears is hazardous.

Although some belittle the importance of fusiform bacilli and spirilla in ulceromembranous lesions, one should not forget the possibility of gangrenous stomatitis and pyemia if lesions are untreated.

Although we do not know the significance of the many spirochetes and fusiform organisms not associated with an acute Vincent's infection, their presence, as well as that of Vincent's organisms in large numbers, is a sign of a lack of oral hygiene, and the conditions favoring their growth should be removed.

We must bear in mind the possibility of lung infections if these various anaerobic organisms are aspirated, especially after extraction of teeth or removal of tonsils.

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RATE AND DIRECTION OF ORTHODONTIC CHANGE AND EFFECT ON INCIDENCE OF CARIES IN FIVE HUNDRED ADOLESCENTS FOLLOWING CARIES, FILLING OR EXTRACTION OF FIRST PERMANENT MOLARS

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OCCLUSAL CHANGES AND CARIES INCIDENCE FOLLOWING EXTRACTION OF FIRST PERMANENT MOLARS

EXTRACTION of the first permanent molars during childhood is followed by certain changes in the dentition. When the mouth is again examined at the end of the adolescent period, from 15 to 19 years of age, there are seen well-defined changes which are not found in children all of whose first permanent molars are retained in the mouth. These sequelae, as has been shown,[1] manifest themselves in the inclination, rotation, elevation (continuous eruption) and bodily movement of the remaining teeth. The median line is deflected and the symmetry of the face is disturbed. There appears, moreover, a rise in the incidence of caries in direct ratio to the number of first permanent molars extracted per child.

Table 1 shows the number of children in a group of 500 with one to four first permanent molars missing; the actual number of first molars missing; the number of "exteeth"* and the average number of "exteeth" per child correlated to the actual number of first permanent molars extracted per child. Table 1 shows clearly that there is a concomitant increase in the average number of "exteeth" per child as the actual number of first permanent molars extracted per child increases from one to four.

The first and second premolars and second molar were examined in 941 of the jaw quadrants from which the first

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*"Exteeth" are teeth showing some physical abnormality acquired since their eruption. They include those filled, carious, extracted or redecayed or remaining roots.

molar had been extracted. Six combinations of change of position in the above-molars had been extracted, 67 per cent evidenced a definite change of position

TABLE 1.—DATA ON CASES IN WHICH ONE, TWO, THREE OR FOUR FIRST PERMANENT MOLARS WERE EXTRACTED

First Permanent Molars Missing Per Child	Children	First Permanent Molars Missing	"Exteeth"	Average "Exteeth" per Child
1	200	200	1,848	9.2
2	184	368	1,913	10.3
3	87	261	960	11.0
4	29	116	411	14.0
Total	500	945	5,132	10.25

TABLE 2.—EFFECT ON POSITION OF FIRST AND SECOND PREMOLARS AND SECOND MOLAR IN 941 JAW QUADRANTS FROM WHICH FIRST MOLARS HAVE BEEN EXTRACTED

First Premolar	Second Premolar	Second Molar	Symbol Designation	Number of Quadrants	Percentage of Quadrants
No Movement	No Movement	No Movement	=O-O-O	14	1.6
No Movement	Moved	No Movement	=O-D-O	6	0.63
Moved	Moved	No Movement	=D-D-O	55	5.8
No Movement	No Movement	Moved	=O-O-M	128	13.6
No Movement	Moved	Moved	=O-D-M	101	10.7
Moved	Moved	Moved	=D-D-M	637	67.6
			Totals	941	99.93

TABLE 3.—NUMBER OF CHILDREN STUDIED (15 TO 19 YEARS) WITH NONE TO FOUR OF THE FIRST MOLARS FILLED OR CARIOUS

First Permanent Molars Filled or Carious	Age 15	Age 16	Age 17	Age 18	Age 19	Total
0	21	44	44	18	23	150
1	28	66	46	19	31	190
2	26	68	58	30	18	200
3	29	92	50	23	6	200
4	20	95	63	17	5	200
Total	124	365	261	107	83	940

mentioned teeth were found to have taken place. (Table 2.)

Figure 1 shows that in 941 jaw quadrants from which the first permanent in a distal direction of the first and second premolars plus a mesial drift of the second molar; in 5.8 per cent, there was a distal drift of the first and second

TABLE 4.—NUMBER OF CHILDREN, "EXTEETH" AND AVERAGE "EXTEETH" PER CHILD BY AGE GROUPS (15 TO 19 YEARS) RELATED TO ACTUAL NUMBER OF FIRST PERMANENT MOLARS FILLED OR CARIOUS PER CHILD

TABLE 4.—NUMBER OF CHILDREN, "EXTEETH" AND AVERAGE "EXTEETH" PER CHILD BY AGE GROUPS (15 TO 19 YEARS) RELATED TO ACTUAL NUMBER OF FIRST PERMANENT MOLARS FILLED OR CARIOUS PER CHILD

Age	First Permanent Molars Filled or Carious = 0		First Permanent Molars Filled or Carious = 1		First Permanent Molars Filled or Carious = 2		First Permanent Molars Filled or Carious = 3		First Permanent Molars Filled or Carious = 4	
	Children	"Exteeth"	Children	"Exteeth"	Av. "Exteeth"	Children	"Exteeth"	Av. "Exteeth"	Children	"Exteeth"	Av. "Exteeth"
15	21	38	28	86	3.0	26	122	4.7	29	226	7.7	20	196	9.8
16	44	58	66	203	3.0	68	364	5.4	92	650	7.0	95	864	9.1
17	44	65	46	152	3.3	58	322	5.5	50	408	8.1	63	591	9.3
18	18	34	19	67	3.5	30	183	6.0	23	204	8.0	17	168	9.8
19	23	21	31	98	3.0	18	125	6.9	6	61	10.0	5	58	11.6
Total	150	216	190	606	3.2	200	1,116	5.6	200	1,549	7.5	200	18.8	9.4

premolars only; while, in 13.6 per cent, there was a mesial drift of the second molar only. The last two categories mentioned (distal movement of premolars only or mesial movement of second molars only) were not found in the jaw quadrants from which the first molar had been extracted eight years earlier, and but few remained in those positions after three years; while combined distal movement of the premolars plus mesial movement of the second molars was found at all intervals from three months to twelve years or more after the first molars were extracted. This shows a prevailing tendency for the premolars to change their position distally as well as for the second molars to drift mesially in those quadrants from which the first molars had been extracted; which leads to a general disturbance in the occlusion of the teeth in the entire mouth.

TABLE 5.—AVERAGE NUMBER OF EXTEETH PER CHILD (15-19 YEARS) EXCLUDING FIRST PERMANENT MOLARS RELATED TO THE NUMBER OF FIRST PERMANENT MOLARS FILLED OR CARIOUS PER CHILD

Age	0	1	2	3	4
15	1.8	2.0	2.7	4.7	5.8
16	1.3	2.0	3.4	4.0	5.1
17	1.4	2.3	3.5	5.1	5.3
18	1.8	2.5	4.0	5.8	5.8
19	0.91	2.0	4.9	7.1	7.6

There is a marked increase in the number of "exteeth" per child for the mouth as a whole, shown by children with missing first permanent molars when compared with children of similar age groups who have not lost any of their first molar teeth.[2, 3]

AGE AND CARIES OR FILLINGS IN FIRST PERMANENT MOLARS RELATED TO GENERAL CARIES INCIDENCE

In order to determine whether the increase in the number of "exteeth" is

TABLE 6.—PERCENTAGE OF CHILDREN WITH NO TO TWENTY-ONE "EXTEETH" PER CHILD RELATED TO ACTUAL NUMBER OF FIRST PERMANENT MOLARS FILLED OR CARIOUS PER CHILD

First Permanent Molars Filled or Carious per Child	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
0	38	22.7	20.7	8	4.6	2.0	1.3	2.0	0.7													
1		22.2	22.7	18.6	15.8	8.5	5.3	2.7	3.2	0.5							0.5					
2			0.8	17	14.0	16.5	13.5	10.5	7.5	6.0	2	1.0	1.0	1.5	1	0.5						
3				3.5	4.5	15.5	14.0	14.5	14.5	11.5	6	7.5	2.0	3.0	1		0.5	1.5				0.5
4					3.0	4.0	6.5	10.5	21.5	15.5	10	7.0	7.0	3.5	5	3.5	0.5	1.5		0.5		0.5

caused by the increased incidence of extraction of first permanent molars or whether the extractions *per se* were the end-result of an existing high caries incidence, a group of boys and girls, from 15 to 19 years of age, who had all of the first molars were examined. The first permanent molars in this group, while all retained in the mouth, were classed as free of caries, filled or carious.

Table 3 shows the distribution according to age groups of the total number of boys and girls from 15 to 19 years (940), and the relation of the number in each age group to the actual number of first permanent molars free of caries, filled or carious. There were only 150 children out of a total of 8,000 examined at the clinic who showed all of four first permanent molars free of caries or fillings. This does not mean that all of the 150 children out of a total of 8,000 examined some had one or two and a few even more carious teeth present. Only 190 of a total of 8,000 children were found to have only one first permanent molar filled or carious with the remainder in good condition. It was comparatively easy to find children with two, three or four carious or filled first molar teeth. However, the latter groups were limited to 200 children each for the purpose of this study.

Table 4 shows the number of children by age groups who had all four of the first permanent molars and the number of these teeth that were free of caries, carious or filled. The number of "exteeth" and average number of "exteeth" in each group are also shown in relation to age from 15 to 19 years, as are the total number of children examined, the total number of "exteeth" and the average number of "exteeth" in each group in relation to the fact that any or all four of the first permanent molars were free of caries, were filled or were carious. Table 3 also summarizes the number of children, the number of "exteeth" and the average number of

"exteeth" as related to the actual number of first permanent molars per child free of caries, filled or carious. We see here that the average number of "exteeth" per child increases from 1.44 for those children with all four first permanent molars in normal condition to 9.4 for those with all of the four first permanent molars filled or carious. The average for the group as a whole is 5.7 "exteeth" per child.

Figure 2 shows graphs which indicate the average number of "exteeth" for the mouth as a whole in each group of children according to age as related to the actual number of first molars found free of caries, filled or carious. The crossing of the graphs for the various age groups indicates that the increase in age from 15 to 19 years is not a significant factor in the increase in "exteeth." However, the average number of "exteeth" per child for all age groups increased from 1.4 to 9.4 as the actual number of filled or carious first permanent molars increased from none to four per child.

Table 5 shows the average number of "exteeth" per child in the mouth as a whole, excluding "exteeth" in the first permanent molars themselves, in each of the various age groups separated according to the number from none to four first permanent molars filled or carious. There is a rise in the caries incidence in the remaining teeth of the mouth with an increase in the actual number of first permanent molars filled or carious. This would indicate that the first permanent molars can be used as an index of the caries incidence for the mouth as a whole.

TABLE 7.—AVERAGE NUMBER OF "EXTEETH" PER CHILD RELATED TO ACTUAL NUMBER OF FIRST PERMANENT MOLARS FILLED OR CARIOUS AND COMPARED WITH THE ACTUAL NUMBER OF FIRST PERMANENT MOLARS EXTRACTED

First Permanent Molars Filled or Carious	Missing First Permanent Molars				
	0	1	2	3	4
0	1.4	4.1	5.5	9.9	14.6
1	3.2	5.0	8.0	11.3	
2	5.6	7.0	11.2		
3	7.8	10.8			
4	9.4				

DISTRIBUTION OF CHILDREN BY "EXTEETH" RELATED TO CARIES OR FILLINGS IN FIRST PERMANENT MOLAR

Table 6 shows the percentage of children in the group of 940 examined who had from none to four of the first permanent molars filled or carious as related to the actual number of "exteeth" from none to twenty-one per child.

TABLE 8.—AVERAGE NUMBER OF "EXTEETH" PER MOUTH EXCLUDING FIRST PERMANENT MOLARS RELATED TO ACTUAL NUMBER OF FIRST PERMANENT MOLARS EXTRACTED, FILLED OR CARIOUS PER MOUTH AND COMPARED WITH AVERAGE NUMBER OF "EXTEETH" PER MOUTH WHEN FIRST PERMANENT MOLARS ARE FILLED OR CARIOUS ONLY

First Permanent Molars Filled or Carious	First Permanent Molars Extracted				
	0	1	2	3	4
0	1.4	3.1	3.5	6.9	10.6
1	2.2	3.0	5.0	7.3	
2	3.6	4.0	7.2		
3	4.8	6.8			
4	5.4				

Figure 3 shows graphs based on Table 6 indicating the percentage of children with none to all four of the first permanent molars filled or carious as related to the actual number of "exteeth" per mouth.

Figure 4, a bar graph based on Table 6, depicts the distribution of the percentage of children with none to four of the

first permanent molars filled or carious in each of the subdivisions from none to twenty-one "exteeth" per child. While the "exteeth" in the total of 940 children examined ranged from none to twenty-one per child, those with normal first molars fell primarily into the categories from none to two "exteeth" per child, and as the actual number of first molars filled or carious per child increased, the children were found more frequently distributed in the higher "exteeth" subdivisions.

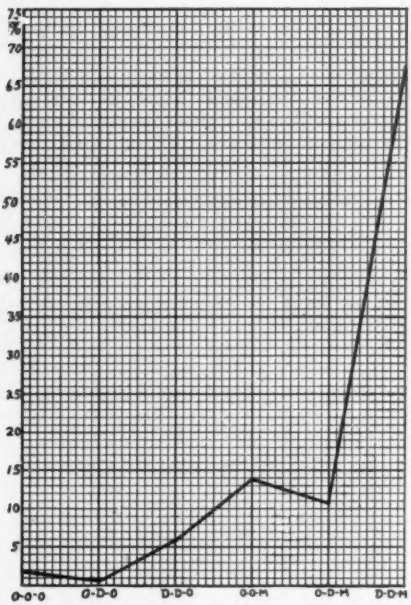


Fig. 1.—Percentage frequencies of 941 quadrants in various positions at time of examination.

COMPARISON OF "EXTEETH" IN FILLED OR CARIOUS FIRST PERMANENT MOLARS WITH EXTRACTED FIRST PERMANENT MOLARS

Figure 5 is an isometric graphic comparison of the average number of "exteeth" per child in the two categories of children; namely, those with first permanent molars filled and those with first permanent molars extracted. We can see here that there is an increase of "exteeth" with the increase in the actual number of first permanent molars filled or carious. There is also an increase in "exteeth" with the increase in the actual number of first permanent molars extracted. However, in all cases, the average number of "exteeth" per child is greater among those with first permanent molars extracted than among those who retained the first permanent molars.

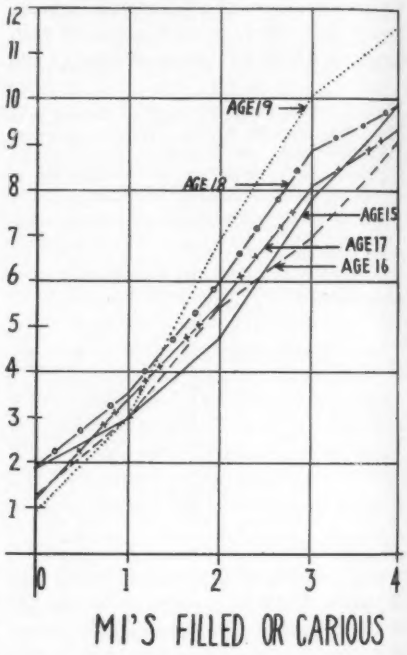


Fig. 2.—Distribution of average number of "exteeth" per mouth, by age groups 15 to 19 years, related to actual number of M1's filled or carious.

RELATION OF "EXTEETH" INCIDENCE TO INCIDENCE OF EXTRACTED, FILLED OR CARIOUS FIRST PERMANENT MOLARS

Table 7 shows the average number of "exteeth" per child distributed according to the actual number of first permanent molars extracted per child and as related to the number of the re-

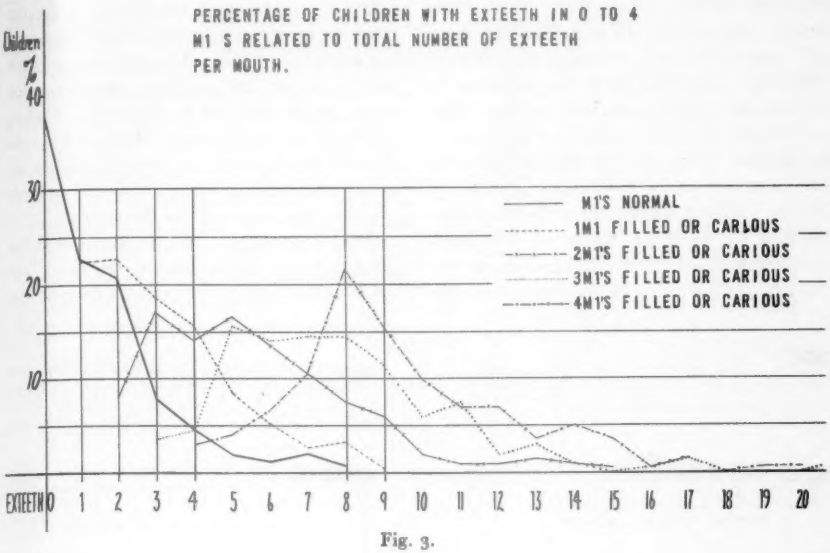

PERCENTAGE OF CHILDREN WITH EXTEETH IN 0 TO 4
M1 S RELATED TO TOTAL NUMBER OF EXTEETH
PER MOUTH.
Children
%
40
30
20
10
M1'S NORMAL
1M1 FILLED OR CARIOUS
2M1'S FILLED OR CARIOUS
3M1'S FILLED OR CARIOUS
4M1'S FILLED OR CARIOUS
EXTEETH 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Fig. 3.

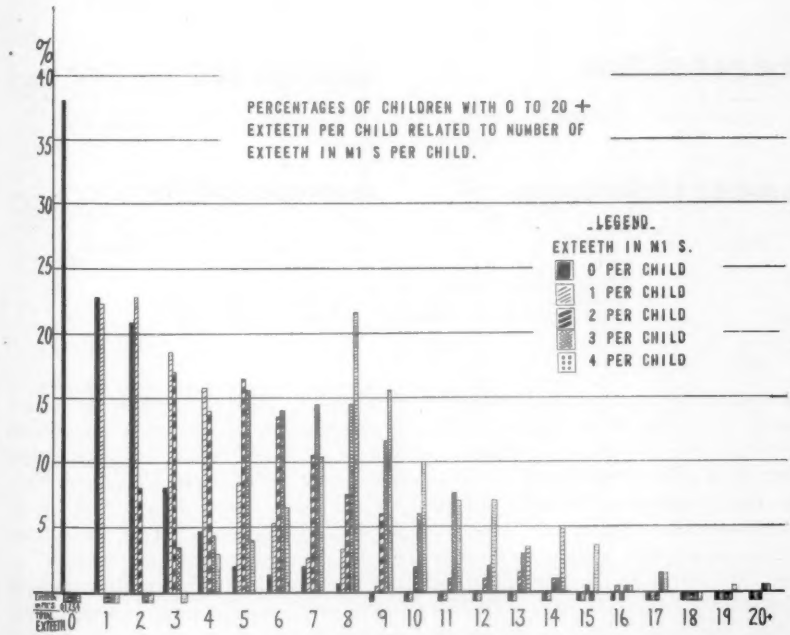
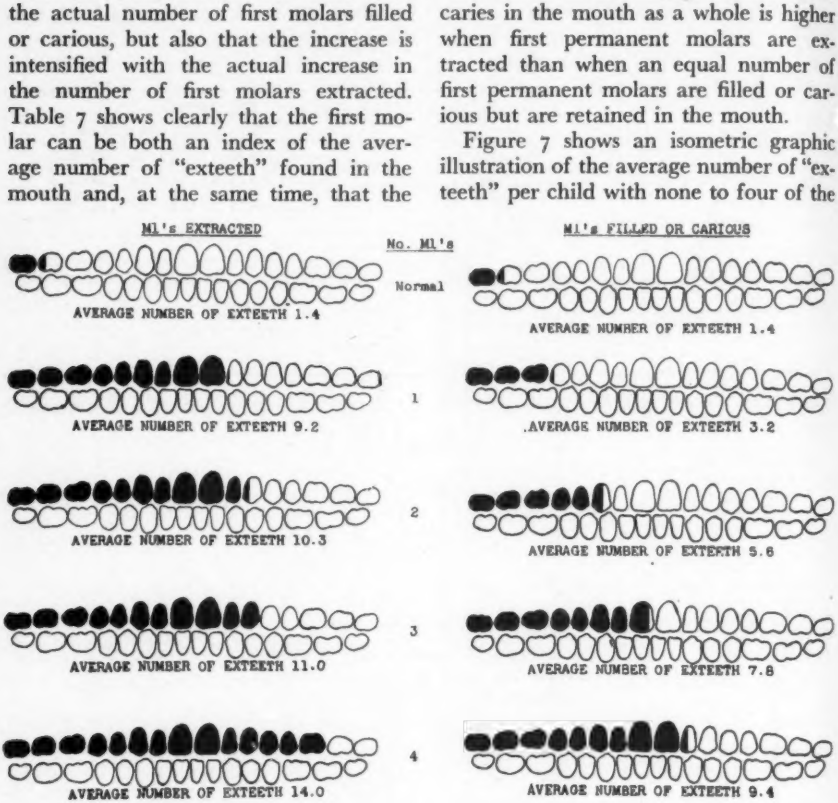

%
40
35
30
25
20
15
10
5
PERCENTAGES OF CHILDREN WITH 0 TO 20 + EXTEETH PER CHILD RELATED TO NUMBER OF EXTEETH IN M1 S PER CHILD.
LEGEND.
EXTEETH IN M1 S.
0 PER CHILD
1 PER CHILD
2 PER CHILD
3 PER CHILD
4 PER CHILD
EXTEETH 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20+

Fig. 4.

maining molars that were free from caries, carious or filled. We see here not only that the average number of "exteeth" increases with the increase in the actual number of first molars filled or carious, but also that the increase is intensified with the actual increase in the number of first molars extracted. Table 7 shows clearly that the first molar can be both an index of the average number of "exteeth" found in the mouth and, at the same time, that the with one to four of the first permanent molars extracted and the remaining ones in normal condition. The tendency shown here is that the average incidence of caries in the mouth as a whole is higher when first permanent molars are extracted than when an equal number of first permanent molars are filled or carious but are retained in the mouth.

Figure 7 shows an isometric graphic illustration of the average number of "exteeth" per child with none to four of the



AVERAGE NUMBER OF EXTEETH PER CHILD WITH M1's EXTRACTED COMPARED WITH M1's FILLED OR CARIOUS AND RELATED TO THE ACTUAL NUMBER OF M1's EXTRACTED, FILLED OR CARIOUS PER CHILD.

Fig. 5.

extraction of the first molars is in itself a factor in increasing the incidence of "exteeth" in the mouth as a whole.

Figure 6 is a bar graph based on some of the data presented in Table 7. We see here the average number of "exteeth" per child, in a group with none to four of the first permanent molars filled or carious and the remaining ones in normal condition, compared with a second group first molars filled or carious as related to the number of first molars extracted and as to whether the remaining first permanent molars were filled or carious. We see here that children with all of the first molars present show an increase in the average number of "exteeth" as the number of the first molars showing fillings or caries increases. However, children with one of the first molars missing

show a correspondingly higher average number of "exteeth" with the increase of caries or fillings in the remaining three molars. The average increase in the incidence of "exteeth" per mouth becomes greater with each additional first permanent molar extracted.

Table 8 shows the average number of "exteeth" in a group of children with none to four of the first molars filled or carious as compared with respective groups of children who have one to four of the first molars extracted and whose

AVERAGE WEIGHTED NUMBER OF EXTEETH PER CHILD RELATED TO ACTUAL NUMBER OF M1'S FILLED OR CARIOUS COMPARED WITH ACTUAL NUMBER OF M1'S EXTRACTED.

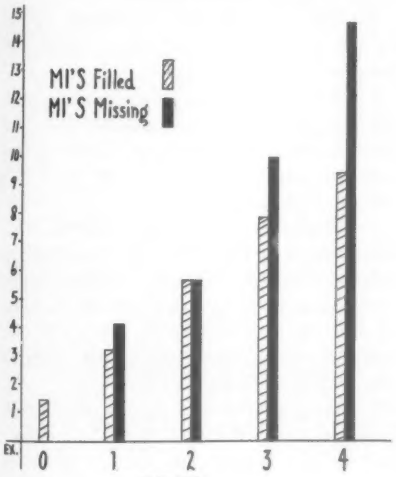
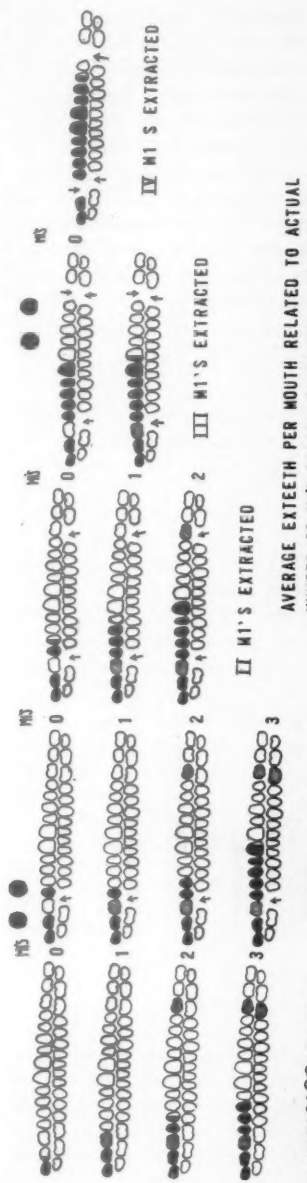


Fig. 6.

remaining first molars show fillings or caries. In Table 8, the "exteeth" in the first molars themselves have been omitted so that the averages would not be influenced by the first molars, but would show the condition of the rest of the mouth in relation to that of the first permanent molars. We find here again that the average number of "exteeth" in the rest of the mouth rises with the increase in the actual number of the remaining first molars filled or carious, but that the increase is intensified with the increase in the actual number of first molars extracted.



AVERAGE EXTEETH PER MOUTH RELATED TO ACTUAL NUMBER OF M1'S FILLED OR CARIOUS COMPARED WITH AVERAGE EXTEETH PER MOUTH WHEN 1,2,3 OR 4 FIRST MOLARS ARE EXTRACTED AND THE REMAINING M1'S FREE FROM CARIES, FILLED OR CARIOUS.

Fig. 7.

Figure 8 shows that while there is an increase in the average number of "exteeth" in the mouth as a whole with the increase in the number of first permanent molars filled or carious, the increase in the average number of "exteeth" in the mouth as a whole is intensified with the increase in the actual number of first permanent molars extracted. In other words, the number of fillings or carious areas in the first permanent molars can be made to serve as an index of the caries incidence of the mouth as a whole. At the same time, there is a tendency for these children to show an increase in the average number of carious areas in the mouth as a whole with the increase in the number of first permanent molars extracted per mouth.

AVERAGE WEIGHTED NUMBER OF EXTEETH PER CHILD, EXCLUDING EXTEETH IN M1S, RELATED TO NUMBER OF M1S EXTRACTED AND NUMBER OF REMAINING M1S FILLED OR CARIOUS.

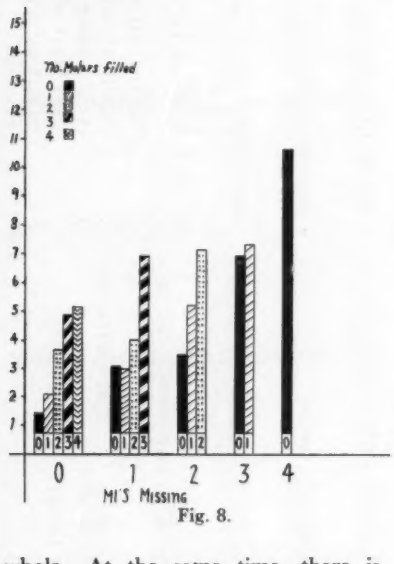


Fig. 8.

SUMMARY

1. Changes in dental occlusion, increases in caries incidence and disturbances in facial symmetry not found when the first permanent molars are retained in the mouth are seen in children with one to four of the first permanent molars extracted.

2. There is a concomitant increase per child in the average number of "exteeth"; i.e., teeth showing physical defects acquired since eruption, with the increase in the actual number of first permanent molars extracted per child.

3. In a group of 8,000 children from 15 to 19 years of age, only 150 were found to have all of the first permanent molars present in the mouth and free from caries. There were only 190 children with just one molar filled or carious in the 8,000 available records.

4. The increase in age from 15 to 19 years is not an important factor in the rise of caries incidence.

5. With the increase in the actual number of first permanent molars filled or carious, there is a concomitant rise in the average number of "exteeth" for the mouth as a whole.

6. The incidence of "exteeth" in children with from one to four first molars extracted is, in all cases, higher than in a group with a corresponding number of first molars filled or carious only, but with all of the first permanent molars retained in the mouth.

7. According to the actual number of "exteeth" per child, as the actual number of first permanent molars filled or carious increases, there is a tendency for the children to show an increase in the actual number of "exteeth" in the mouth as a whole.

8. Among children who have from one to all four of the first permanent molars extracted, there is an increase in the average number of "exteeth" with the actual increase in the number of first molars lost as well as with the increase of caries or fillings in the remaining first molars.

9. Children with one to all four of the first permanent molars filled or carious

when all of these teeth are retained in the mouth show fewer "exteeth" in the mouth as a whole in comparison with children who have an equal number of the first permanent molars extracted, even when the remaining first molars are free from caries.

10. When the "exteeth" in the first permanent molars themselves are excluded from the correlation, an increase is found in the average number of "exteeth" in the mouth as a whole with the increase of fillings or caries in the first permanent molars remaining in the mouth. However, the increase in the incidence of "exteeth" is intensified when the first molars are extracted. The incidence of "exteeth" in turn rises with the increase in the number of first permanent molars extracted.

CONCLUSIONS

These conclusions are naturally based on the data here presented and refer to the cases correlated. In order to determine whether the conclusions would also hold true universally, additional statistical work is necessary. The data presented here indicate that these children show an increase in the average incidence of caries for the mouth as a whole in direct ratio to the actual number of carious or filled first permanent molars when all of these teeth are retained in the mouth. In children with from one to all four of the first molars extracted, there is an increase in the number of carious areas in direct ratio to the increase in the actual number of first molars extracted and also to the increase in the actual number of areas of caries or number of fillings in the remaining first molars. In all cases, however, children with extracted first molars show a higher incidence of caries than those with a corresponding number of first molars filled or carious and retained in the mouth. We may conclude, therefore, that (1) the number of filled or carious first permanent molars can be used as an index to the caries incidence of the mouth as a whole; (2) extraction of the first permanent molars is a direct factor in the increase in caries in the mouth as a whole, of these children, and (3) orthodontic and facial changes following disturbance of the occlusion, as shown in previous studies, are the result of drifting of the remaining teeth in the jaw quadrants from which the first permanent molars have been extracted.

The dentist has here been provided with data showing the advantage of retaining first permanent molars in the mouth; the fallacy of extracting these teeth as an orthodontic measure, and, conversely, reasons for the immediate replacement or for space retention of extracted first permanent molars regardless of the age of the child at the time when this tooth is extracted.

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654 Madison Avenue.

STREPTOCOCCUS VIRIDANS: BACTERIEMIA FOLLOWING EXTRACTION OF THE TEETH

By Joseph Anthony Hopkins, D.D.S., Rockford, Ill.

In the past two years at the pathologic conferences of the Rockford Hospital, conducted by H. D. Palmer, M.D., and M. Kempf, B.A., in ten of thirteen cases presented death followed multiple extraction of teeth. In three cases, there was a history of onset following manipulation of infected gums.

I shall present four cases with complete case histories taken from the Rockford clinical conference records, and one case from a series of 100 cases studied at the Winnebago County Hospital. Case histories were not fully complete in seven cases.

In a study of this kind, it is imperative that a complete clinical history be recorded, with necropsy records.

Dr. Palmer, Miss Kempf[1] and I had decided to make a study of bacteriemia following tooth extraction in 100 cases. We did not make any selection of cases except to limit them to those in which only one or two extractions were performed at one time. Most of us in former years were no doubt overenthusiastic regarding the number of extractions to be made in these focal infection cases, and, no doubt, every hospital in the country can show many fatalities following multiple extraction of teeth.

In the 108 cases at the Winnebago County Hospital, every patient was given a complete dental examination, consisting of full mouth x-ray examination, pulp testing and clinical examination. Ten cubic centimeters of blood was taken from the patient's arm immediately before extraction, and 10 cc. at each five-minute period up to thirty minutes after the extraction of teeth.

Each 10 cc. of blood was recorded, properly marked and cultured in brain veal infusion broth, containing 0.1 to 1 per cent agar. This was subcultured at the end of forty-eight hours and again at the end of seven days.

All cultures taken before operation were sterile. Eighteen out of a little more than 100 cases gave 16.6 per cent positive blood cultures immediately after operation. In seventeen of the eighteen cases that gave positive cultures immediately after operation, the blood was sterile fifteen to thirty minutes later. The other case showed a second positive culture ten minutes after the operation. In fourteen of the cases with positive blood cultures, the organism was *Streptococcus viridans,* and, in the other four cases, *Staphylococcus aureus* (hemolytic) was cultured. This report shows how transient this bacteriemia is in the blood stream.

Only one of the eighteen cases that showed transient bacteriemia developed any elevation of temperature after operation (Case 6).

That *Streptococcus viridans* enters the blood stream much more frequently than it produces secondary foci of localization has been pointed out, but has not been generally appreciated. Even though it is often associated with other organisms in alveolar infections, it invades the blood

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stream from the focus much more frequently than all other organisms combined.

Subacute bacterial endocarditis is a secondary focus of infection, not a primary one. *Streptococcus viridans,* which causes it, is ordinarily a relatively harmless organism, but is capable of proliferating and causing a progressive infection of the damaged area of a rheumatic or a congenitally malformed heart. The direct relationship between foci in the mouth and the onset of this disease has been stressed by several investigations.[2-8]

O'Kell and Elliott[9] found transient *Streptococcus viridans* bacteriemia in eighty-four (60.9 per cent) of 138 cases of extraction. He also found, in severe cases of alveolar infection after multiple extraction, 75 per cent that showed positive blood cultures immediately after operation. These authors found that the occurrence and degree of bacteriemia depended on the severity of the alveolar infection and the amount of damage done at the operation. In all of these cases, they showed that the bacteriemia was of short duration. Ten minutes or more after the operation the cultures were sterile.

In the following cases, reported from Dr. Palmer's[1] clinical pathologic conference, relationship of the onset of sepsis to traumatization of foci in the mouth is intimate.

Case 1.—*History.*—A white man, aged 44 had always enjoyed satisfactory health in spite of the presence of a congenital cardiac lesion, because of which he had been spared strenuous activities. He had been able to live an ordinary school and business life without physical complaint. Immediately after the extraction of several teeth in December 1936, he complained of weakness, sweating and mild prostration, and had fever of the septic type. The morning temperature was usually normal, but there was a temperature of 100 to 101° each evening.

Examination.—The pulse was 110, blood pressure, systolic, 138; diastolic, 75. The area of cardiac dulness was enlarged approximately 2 cm. to the left. There was a harsh, roaring "machinery murmur" with greatest intensity at the second and third interspaces to the left of the sternum. In spite of the great intensity, the sound was not widely transmitted and did not extend more than 5 cm. in any direction from the pulmonic valve area. The murmur was systolic in time and continued throughout most of the diastole. The spleen was palpable, but not painful. The hemoglobin was 11 gm.; red blood count, 4,290,000; white blood count, 8,350. Blood cultures yielded *Streptococcus viridans.*

Course.—The condition continued for one year with little variation. Petechiae of the skin or mucous membranes were never observed. The patient had drenching night sweats, afternoon fever and a gradually developing pallor. Cyanosis was not observed. During the last four weeks only did he complain of pain. This was in his "lungs" and he was unable to lie on either side. Positive blood cultures for *Streptococcus viridans* were obtained upon each attempt.[4]

Outcome.—The patient died in December 1937, with evidence of increasing cardiac failure. The clinical diagnosis was subacute bacterial endocarditis implanted upon a congenital anomaly.

Necropsy.—There was a small amount of fluid in each pleural cavity. The heart was surrounded by 500 cc. of serofibrinous exudate and the pericardial surfaces had a shaggy "bread and butter" appearance. The heart weighed 550 gm., with a transverse diameter of 16 cm. The right side was especially enlarged. The pulmonary artery was greatly enlarged. The pulmonic leaflets were thickened by large gray vegetations and thrombi. The valve was incompetent. Vegetative masses extended upward on the wall of the pulmonary artery, and, on the left lateral wall, there was a mycotic aneurysm 4 cm. in diameter. This was partially lined by clot, but had completely destroyed the wall except for the pericardium.

This lesion explains the origin of the pericarditis. *Streptococcus viridans* was present in the pericardial exudate. The orifice of the left pulmonary artery was the upper limit of the aneurysm. Anterior to this opening was the orifice of a patent ductus arteriosus 1.5 cm. in diameter. There was

much calcification of the wall of the ductus arteriosus and of the adjacent areas in the pulmonary artery and aorta. The lungs were edematous and relatively atelectatic throughout.

Dissection of the pulmonary arteries revealed multiple mycotic aneurysms, varying in diameter from a few millimeters to 3 cm. Embolic phenomena were not demonstrated in any part of the greater circulation. Changes in the organs were those that accompany sepsis and chronic passive congestion. The spleen weighed 620 gm. and measured 20 cm. from pole to pole. It was firm and had the uniform redness of reticulo-endothelial hyperplasia.

Microscopically, the aneurysms showed ruptured internal elastic membranes and the sac formed mostly of adventitia. In the kidneys, a few glomerular capillaries contained large number of polyps, and still fewer showed pericapsular areas of inflammation. The picture of multiple embolization of the glomeruli was not present. Microscopic examination of other tissues added nothing to the gross interpretation.

Comment.—In spite of a congenital heart lesion, this patient was subjectively entirely well until he had a number of teeth extracted. Signs of sepsis developed immediately, and *Streptococcus viridans* was recovered from the blood. Embolization within the pulmonary circulation resulted in the development of multiple mycotic aneurysms. Embolization in the greater circulation was possible through the patent ductus arteriosus, but apparently did not occur.

CASE 2.—*History.*—A white woman, aged 35, had rheumatic fever at the age of 4, with several indefinite, but probable recurrences during childhood and adolescence. Tuberculous cervical adenitis developing in 1926 was successfully treated by the x-rays. In 1928, therapeutic abortion was performed because of high grade mitral stenosis. In January 1937, the patient was under treatment for oral sepsis of a pyorrheal nature, and for repair of the teeth. She had gone to the dentist feeling well. Procaine was injected into the gums. The patient returned home. She experienced a chill and the temperature rose to 104. The chills continued. The fever was high and was of the septic type. There were drenching, debilitating sweats. The patient became mildly icteric and was obviously very ill. The pulse ranged around 120. The blood culture yielded 260 colonies of *Streptococcus viridans* per cubic centimeter of blood.

Examination.—The physical findings were those of mitral stenosis and aortic regurgitation. The spleen was tender on palpation 3 cm. below the lower costal margin. There were numerous petechiae in the skin and conjunctivae. The finger and toe pads were tender and showed splinter hemorrhages. The hemoglobin was 8.5 gm.; red blood count, 3,300,000; white blood count, 16,200. Urinalysis revealed an albumin 1+, a trace of blood and sediment loaded with pus cells.

Course.—The duration of the condition was six months. There were frequent showers of emboli to the spleen and in the skin. A high degree of sepsis, with increasing evidence of cardiac failure, characterized the illness.

Necropsy.—There were petechiae in the skin and mucous membranes, slight clubbing of the fingers and slight dependent edema on external examination. There was fluid in all of the cavities. The pericardial sac, which was filled, measured 20 cm. in diameter and reached the lateral chest wall on the left. The heart measured 12 cm. in transverse diameter and weighed 310 gm. The left auricle was enormously enlarged, measuring 10 cm. in depth. Along the posterolateral wall of this cavity were a number of coarse thrombi and smaller vegetations varying from gray to red.

The mitral valve was greatly thickened and the chordae tendineae were shortened. The leaflets were fused, and the orifice, which was fixed and measured only 1 cm. in diameter, was closed by a fresh thrombotic mass which was continuous with older gray vegetations on the valve.

The aortic valve presented similar changes. There was an old rheumatic lesion and the ventricular surfaces were studded with vegetative masses. The edges of the cusps showed moderate ulceration.

The spleen, which weighed 480 gm., showed hyperplasia of the reticulo-endothelium and numerous areas of infarction in various stages of development. The kidneys weighed 320 gm. They were gray, but mottled with red streaks. Microscopically, they showed multiple embolization of the glomerular capillaries. The changes in the other organs

were those of sepsis and chronic congestion.

Comment.—In this case, though no teeth were extracted, there is a history of very closely connected onset of sepsis with dental manipulation including the traumatization incident to procaine injection. A chill with high fever marked the onset almost immediately after manipulation of the focus. An old rheumatic lesion furnished the "suitable soil" for implantation. Richard's[10] experiments are of interest in relation to this case. He obtained positive blood cultures in three of seventeen cases following massage of the gums. About the same percentage of his cases yielded positive blood cultures after massage of the tonsils. In two of his patients, there was a chill following the massage of the tonsils. The situation is apparently comparable to catheter fever.

Case 3.—*History.*—A girl, aged 18, had rheumatic fever with endocarditis at the age of 8. Evidence of mitral stenosis with insufficiency followed the acute attack. At the age of 14, some teeth were removed and a dental bridge was fitted, without incident. Three years later, the patient returned to the dentist for "extensive repair work." Her health at this time was "as well as usual." Several of the teeth were devitalized and filling of the root canals was undertaken. Most of the work was done under procaine infiltration. Within a few days after this dental program had been started, the patient complained of chills, fever, night sweats and loss of strength. She continued to keep dental appointments for a week, but then found it necessary to discontinue them. Pain in the finger and toe pads developed.

Examination.—There was a harsh systolic murmur over the mitral area, with a presystolic thrill. The murmur was transmitted to the axilla. The left border of the heart was outside the midclavicular line. The spleen, which was palpable and tender, reached 4 cm. below the costal margin. The hemoglobin was 65 per cent; red blood count, 3,330,000; white blood count, 5,150. Blood cultures taken on three successive days yielded pure cultures of *Streptococcus viridans.* There were more than fifty colonies per cubic centimeter of blood.

Course.—Cultures taken bimonthly were positive throughout the illness, which lasted five months, ending fatally. The urine contained small amounts of albumin and a small number of pus cells throughout the course of the disease.

Necropsy.—The pleural and peritoneal cavities contained large amounts of fluid. The pericardial sac was obliterated by dense fibrous adhesions. The heart weighed 550 gm. and presented marked enlargement of the left auricle and both right chambers. The mitral leaflets were thickened and fused, and the tendinous cords were thickened and shortened. Large vegetative masses were found on this valve, extending upward on the septal wall of the left auricle and downward over the papillary muscles. The left coronary artery was occluded near its orifice by an embolus made up of vegetative material. Microscopically, the capillaries of the glomeruli of the kidneys contained emboli.

Comment.—This young girl, with a healed rheumatic lesion in the mitral valve, developed a septic condition during extensive dental work under local anesthesia. Death was due to coronary embolism.

Case 4.—*History.*—A man, aged 60, experienced chills and fever and was confined to his home for six weeks after the extraction of the lower teeth. Prior to this time, he had complained of "heart trouble," but there was no accurate description of a preexisting heart lesion. He had recovered sufficiently to return to work, when removal of the teeth from the badly diseased upper gum area was decided on. This experience was followed immediately by chills, afternoon fever, lassitude, loss of strength, loss of weight and night sweats.

Examination and Course.—*Streptococcus viridans* was recovered from the blood stream. There was physical evidence of mitral lesion. The course was septic, and death ensued within six months. Necropsy was not permitted.

Comment.—The clinical history suggests that bacteriemia followed the first extractions, with possible recovery. Progressive fatal bacteriemia with evidence of *Streptococcus viridans* endocarditis followed immediately upon mass extraction of the upper teeth.

Streptococcus viridans admitted to the blood stream by extraction of teeth occasionally localizes in damaged areas in the vascular system other than the heart. The following record is an example:

CASE 5.—A woman, aged 59, who suffered from hypertensive heart disease, had several teeth extracted. Very severe occipital headache and dizziness followed. The temperature rose within a week's time to 104. Coma developed and the patient died eight days after the extraction. A ruptured mycotic aneurysm of a sclerotic cerebellar artery was found at necropsy. *Streptococcus viridans* was recovered from the brain tissue.

CASE 6.—*History.*—A man, aged 78, fairly well nourished, and not acutely ill, with a blood pressure of 150 systolic and 90 diastolic, gave a rambling history, which was hard to evaluate. He complained of pain across the chest of two years' duration and coughing spells of six weeks' duration.

About two years previously, the patient first noticed pain in the anterior chest area on slight exertion. The pain started on the left side and went around the back to the right side of the chest. This had progressed, the pain becoming more frequent and of greater severity. The patient had had numerous attacks of spasmodic coughing, not accompanied by raising sputum. He had headache occasionally, palpitation of the heart and constipation. There was slight nocturia.

Oral examination revealed three loose teeth, with very little attachment.

A diagnosis of myocarditis on an arteriosclerotic basis and chronic bronchitis was made. The patient was discharged October 28, 1937; readmitted February 12, 1938, stating that shortly after his dismissal in October 1937, he had increasing dyspnea, swelling of the ankles and attacks of coughing, gradually increasing in severity until he was forced to remain in bed. The blood pressure was 160/90.

Examination.—Examination of the head and neck revealed bilateral arcus senilis. There was marked wheezing at the lower lobes of the lungs, especially on the left side, with no improvement in resonance. Examination of the heart revealed that the borders were enlarged to the left. There was some dulness at the right sternal border. The tones were soft and the systolic tone at the mitral valve was roughened. The second sound was accentuated. Irregularity was present.

The liver margin was palpable about three fingers below the rib margin.

Diagnosis.—Organic heart disease of arteriosclerotic origin was diagnosed.

Laboratory Findings.—The white cell count was 20,100; red count, 3,580,000; hemoglobin, 72 per cent. The differential count was: polymorphonuclears, 90, 79 filamentous, 11 non-filamentous; lymphocytes 9; monocytes, 1. Achromia was present, with poikilocytosis grade I.

Course.—The patient did not improve and, because of the chronic conditions present, he was transferred to a convalescent home. He had three teeth extracted March 9, 1938. There was a positive culture of *Streptococcus viridans.* After he entered the convalescent home, he began running a temperature of 101 to 103°. Death occurred three weeks later. No history was obtainable from the convalescent home and necropsy was not made.

This case is only one case in the series of one hundred of bacteriemia that ended fatally.

The patient was a very old man with a history of heart disease and arteriosclerosis. There is some doubt in this case whether the extraction of three teeth hastened death. The teeth were extracted because they were very loose and causing considerable pain. Practically all attachment was destroyed around the teeth.

Evidence that the teeth and tonsils are the main portals of entry for *Streptococcus viridans* into the blood stream should provoke serious thought, causing us to stop and think when we have a great many teeth to extract or a gingivectomy to be performed in the presence of debilitating conditions, particularly heart lesions. Conservative treatment will lead to fewer fatalities.

In the Winnebago County Hospital, a man suffering from coronary heart disease with renal complications was given proper rest and other therapeutic treatment. After one month, one tooth was extracted at a time. There were twenty extractions, all carried out separately over a period of one year. In this case, not at any time was there a positive culture. This, no doubt, was due to having the patient in hospital for complete rest for

a month, and also to the fact that only one tooth was removed at a time. The patient is now enjoying good health, with, of course, restriction as to work and exercise.

We have had several hundred root ends of extracted teeth cultured and have found *Streptococcus viridans* the predominating organism in about 90 per cent of cases. In these cases, the teeth may or may not give evidence of infection in the roentgenogram. There no doubt is a constant leak into the blood stream in these cases which may not cause any appreciable damage to distant organs. Some of these patients may be hypersusceptible, and, from long continued oral sepsis and when the reticulo-endothelial system is depressed, the circulation of organisms is not eliminated, and thereby damage to the heart and other tissues of the body results.

In conclusion, I wish to cite the reports of O'Kell and Elliott[9] in which they show 75 per cent bacteriemia occurring immediately after cases of multiple extraction, and Dr. Palmer's[1] report of 100 cases. In this report, we show 16.6 per cent transient bacteriemia following just one or two extractions at one time. This is excluding Case 6, in which three teeth were removed and the cause of death was uncertain.

If we bear in mind that we may produce a bacteriemia with dental operations, the severity depending on the amount of infection present, we shall have fewer fatalities.

A complete history should be taken, and if we suspect that heart lesions may be present, it would be best to have the patient consult a physician for a thorough examination. In this way, we are not shouldering the full responsibility.

Maude E. Abbott[11] lists the following as congenital cardiac symptoms: cyanosis, clubbing of fingers and toes, cyanotic facies, cyanosis retinae and capillary changes.

Thomas Lewis[12] states:

Breathlessness is the main symptom and varies much in its degree. In early congestion of the veins, it is slight at rest. In deeper congestion, it is the chief cause of distress. The breathing is hurried, the rate, however, being usually below 30 and rarely surpassing 35 per minute; it is increased in depth and very often irregular in rhythm, but not forcible. Breathlessness is increased if the patient lies down; these sufferers much prefer a sitting posture (orthopnoea).

Fatigue and Exhaustion.—Fatigue is an early symptom of the late stages of cardiac failure. During walking exercise the patients not only become breathless, but their legs feel heavy, and on reaching home they are abnormally weary. Another symptom coming on during exercise is a sense of sinking, and weakness, associated with tremulousness—a symptom often termed exhaustion. Fatigue is felt by many patients constantly while they lie in bed presenting congestion of the veins.

Fulness of Head—A tense feeling across the forehead is a usual symptom of advanced venous congestion; headache, though not the rule, may replace it.

Pain—Many of these patients complain of aching over the precordium, and when congestion is deep, continuous aching pain of a distressing kind develops in the right hypochondrium.

Cough, accompanied by frothy and sticky or more serous sputum, is frequent in the later stages and often increases distress.

Vomiting is not uncommon after food has been taken and sometimes interferes with the oral administration of drugs.

By taking careful histories, being on the alert to detect any outward sign of cardiac symptoms and performing conservative dental surgical procedures, keeping in mind the occurrence of bacteriemia with multiple extraction, we shall be rendering our patients a greater service.

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Talcott Building.

THE CELLULAR ELEMENTS OF THE SALIVA AND THEIR POSSIBLE RÔLE IN CARIES

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Gottlieb,[1] in 1915, studied the organic structure of the enamel, especially the lamellae and tufts, with relation to caries. He stated that caries progresses along the lamellae, and also that organic matter in the enamel is more abundant in certain parts, particularly in those areas that are susceptible to caries, such as the proximal surfaces. In 1921, Gottlieb[2] claimed that the hornified cuticle covering the surface of the tooth is a protection against caries.

In discussing these and other problems involved in the study of dental caries, Gottlieb advanced the idea that there must be a factor in the saliva which dissolved the keratinous enamel cuticle and organic matrix, and that this made it possible for acids to attack the inorganic part of the tooth. Fantl and Weinmann[3] showed that saliva contains an enzyme which is capable of digesting the proteins found in normal saliva. The enzyme was first believed to digest insoluble proteins added to saliva, but subsequent investigations[4] indicated that the salivary proteins, as well as other soluble proteins, are digested by this enzyme. A study of the saliva of caries-susceptible and caries-immune individuals has shown that the saliva of the immune has more of the proteolytic enzyme factor than that of the susceptible. This was found to be true in about 80 per cent of the cases studied.[5] If the saliva was filtered, the filtrate contained no proteolytic enzyme. Heat (boiling) destroyed the enzyme. Bacteria cultivated from the mouth did not seem to influence proteolysis.[6] From all the experimental data, it was concluded that the production of this enzyme results from the activity of the cellular elements of the saliva, especially from that of the leukocytes. However, the number of

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leukocytes did not coincide with the degree of proteolytic activity.[7]

Willstaetter[8] produced a proteolytic enzyme from leukocytes which he claimed to be identical with an enzyme found in saliva. He was of the opinion that the leukocytes of the saliva had defensive properties. It is known that the saliva has antibacterial properties, and it can be supposed that this property is at least partly bound to the cellular elements in the saliva.

The morphology of the cellular elements of the saliva is a neglected subject in dental literature. Only a few authors mention the existence of cells in the saliva.

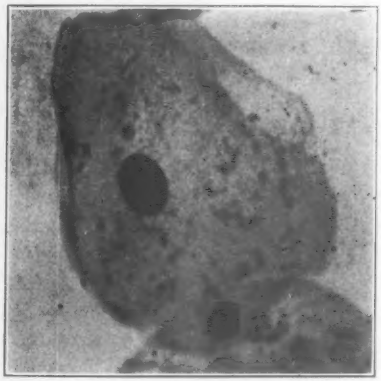

Fig. 1.—Epithelial cells from mouth of caries-susceptible person. The large cytoplasmic body and oval granulated nucleus are characteristic for the epithelial cells. (×1,000.)

W. D. Miller[9] (1890) described the presence of epithelial cells in the saliva, which are, in his opinion, dead cells of the mucous membrane. He also observed that they were frequently covered with bacteria, which he believed destroyed these cells.

G. V. Black[10] (1915) described salivary corpuscles as "spherules of globulin." He could not confirm former statements that these salivary corpuscles might be leukocytes.

J. Mendel[11] (1917) described the cellular elements of the saliva as phagocytes which were identical with polymorphonuclear leukocytes.

Appleton[12] (1933) stated that polymorphonuclear leukocytes were constantly passing through the epithelium of the oral mucosa to the free surface. He thought that these cells were potentially phagocytic and possibly contributed in part to the diminution of the bacterial flora of the mouth.

An interesting study of the salivary leukocytes was published by Isaacs and

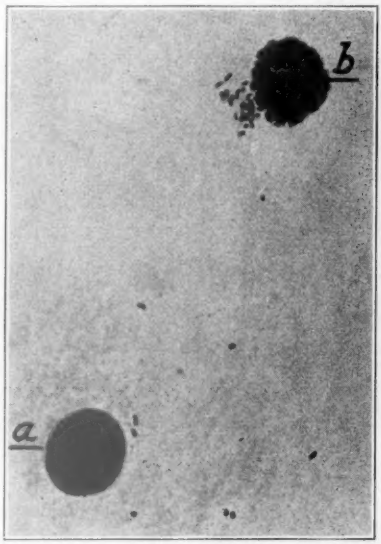

Fig. 2.—Cytoplasm of one of epithelial cells (a) which has almost entirely disintegrated, while that of other (b) has entirely disappeared. (×1,000.)

Danielian[13] (1927), who came to the conclusion that the saliva, as it appeared at the opening of the ducts of the salivary glands, was practically free of leukocytes, and that the leukocytes wandered through the mucous membrane of the oral cavity into the saliva. They found that the number of leukocytes varied between five and 150 per cubic milli-

meter during the course of the day. The variations in the number of leukocytes accompanied the changes in the number of leukocytes in blood, but the relation was most commonly a reciprocal one. If the leukocyte count in the blood was high, it was low in the saliva, and vice versa. The authors did not find a definite relationship between the epithelial cells in the saliva and the number of leukocytes. They stated that while, in some cases, there were many epithelial cells and few leukocytes, others showed the reverse condition.

In opposition to the statement of Isaacs and Danielian, Stephens and Jones[14] ob-

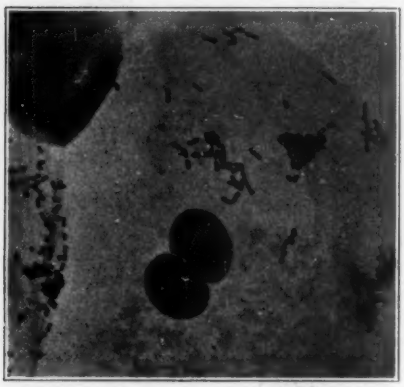

Fig. 3.—Two nuclei in one epithelial cell. (×1,200.)

served no correlation between the total number of leukocytes in the peripheral blood and in the saliva.

B. I. Comroe[15] (1934) described the cellular elements of saliva in relation to systemic disease, but found no definite correlation. He indicated that it was doubtful whether useful diagnostic information could be gained from salivary examination.

From this review of the literature, it can be readily seen that the problem of the cytology of saliva has interested investigators again and again. The function of the different cells in saliva was not studied. Our experience to date shows that there are periodical changes in the cellular content. This was also stated by Isaacs and Danielian.[13] The relation of the rate of flow to the condition and type of cells has not been determined. Earlier investigations pointed to the possible rôle of the cellular elements of saliva in caries.[7] This was our main reason for making investigations in this field, and this study should be considered as the first step in this direction.

Fig. 4.—Two epithelial cells of polygonal shape overgrown by large number of microorganisms. (Specimen from mouth of a caries-free person.) (×1,000.)

METHOD

A loopful of saliva was taken from the buccal fold of the mandible without scraping the surface of the mucous membrane, placed on a slide and smeared over the surface. After drying, the specimens were stained with Wright's stain for one minute, and washed in a buffer solution of pH 6.3 for two to three min-

utes. The smears were taken around 3 o'clock in the afternoon.

We selected two groups of individuals for our investigations—caries-susceptible and caries-immune. The term caries-susceptible is used to designate persons who have a large number of active carious cavities, while the expression caries-immune designates persons who, under their normal living conditions, had no active caries. This lack of caries was of many years' standing and was not due to any dietary or other therapeutic condition. The condition of these subjects was also investigated bacteriologically by counting the culture colonies of the saliva.

Fig. 5.—Two epithelial cells partly overlapping each other and covered by bacteria. (Smear from mouth of caries-immune person.) (×1,000.)

RESULTS

Two groups of cells were observed in the stained smears, epithelial cells and leukocytes.

Figure 1 shows two epithelial cells from a mouth with a high caries incidence. The cells show large cytoplasmic bodies and oval nuclei. The cell body may be round, elliptic or irregular. The cells are found singly or in groups of two or more. They are usually flat, sometimes folded, and their cytoplasm often contains coarse granules. Their edges may overlap each other and their nuclei are granulated and deeply stained by the basic dyes. In the first figure, only a few bacteria are seen in the cytoplasm.

Sometimes the cytoplasm is found as a faint shadow around the well-stained nucleus, or is entirely invisible. (Fig. 2.) One of the cells shows a few bacteria in its pale cytoplasm. The cytoplasm has

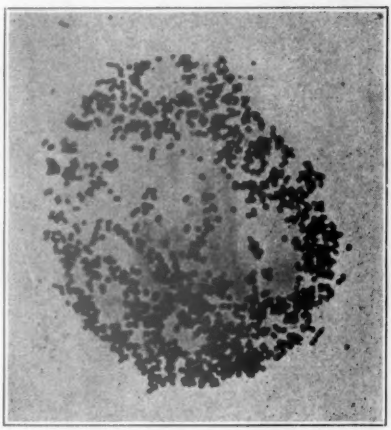

Fig. 6.—Epithelial cell without nucleus (hornified). The outline of the cell can be recognized only by the bacterial colony. (×1,000.)

no definite outline. The other body, which has no visible cytoplasm, can be recognized by its granular structure as the nucleus of an epithelial cell. A group of bacteria are lying adjacent to the nucleus, which has an irregular surface. Epithelial cells with two nuclei are seen occasionally. (Fig. 3.) The nuclei in this picture are close to one another. However, cells were observed in which the nuclei were farther apart. In histo-

logic section of the gingivae, cells with two nuclei are also found in the epithelium of the mucous membrane.

Figure 4 shows two polygonal epithelial cells. The cytoplasm, which is granular, contains a larger number of bacteria. Some bacteria are lying beside the border of the cells. In some instances, the bacteria appeared to be lying on the surface; in others, they seemed to be lying in the cells. In certain mouths, comparatively few bacteria were associated with the epithelial cells; while the reverse was true in others.

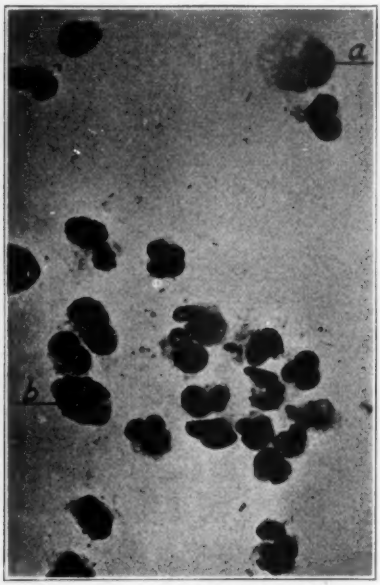

Fig. 7.—Smear from mouth of caries-susceptible person. There are a large number of leukocytes in fairly good condition. The cell (a) degenerated. The nucleus (b) is that of an epithelial cell, the cytoplasm of which has disintegrated. (×1,000.)

Figure 5 shows two epithelial cells partly overlapping each other and overgrown by bacteria. This smear was taken from the mouth of a person who was immune to caries. The body of one of the cells is almost invisible. It was detected owing to the presence of the bacteria. The nucleus, covered by bacteria, is less well stained than those shown in the previous pictures. The other cell in Figure 5 also shows signs of degeneration. The cytoplasmic body, containing granules and vacuoles, is not sharply outlined. The nucleus is neither round nor granulated, but small, faint and flattened. In some instances, the cell could be recognized by the outline of the bacterial colony. (Fig. 6.) The cytoplasm and nucleus had entirely disappeared. In some specimens, we observed epithelial cells without nuclei, but with well-preserved cytoplasmic bodies.

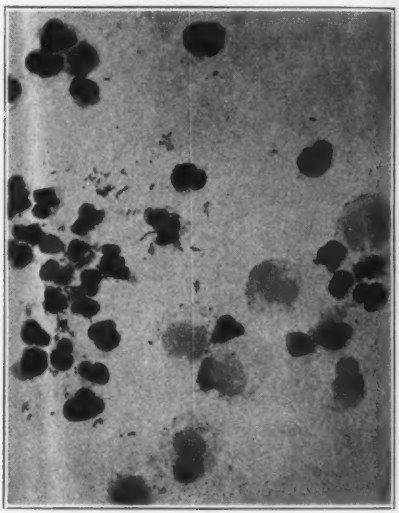

Fig. 8.—Leukocytes of saliva of caries-susceptible person. Most of the cells are well preserved. Some are only "ghosts." (×1,000.)

The majority of leukocytes in saliva appear to be polymorphonuclear. (Fig. 7.) The nuclei, appearing granulated, have two, three or four lobuli. The cell body seldom appears well preserved. It is usually seen as a shadow around, or on, one side of the nucleus. Distinct

granulation in the cytoplasm cannot be recognized. A regular phagocytosis is seldom observed, and in only a few instances could bacteria be seen in close proximity to the leukocytes. Some of the cells show an abnormal staining reaction. They appear larger and their nuclei are less distinct. The cell in the upper right hand corner of Figure 7 is remarkable in this respect. A nucleus of an epithelial cell, without cytoplasm, is mixed with the leukocytes. (Fig. 7.) The

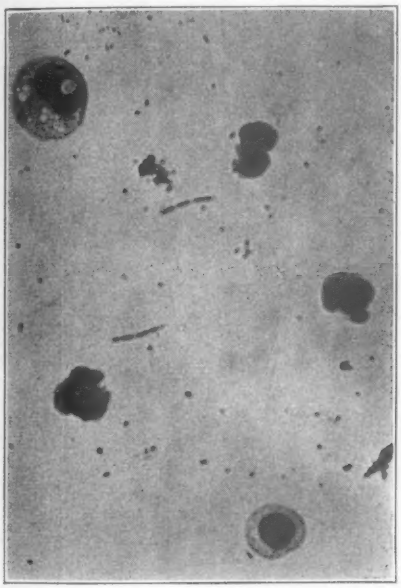

Fig. 9.—Smear from mouth of caries-immune person. The leukocytes show varying stages of disintegration. (×1,200.)

shape of the nucleus and its well-defined granular appearance help to identify it. In certain specimens, the process of disintegration is so far advanced that only remnants of some of the cells can be observed. (Fig. 8.) Various stages of disintegration are seen. Smaller and larger cells are mixed. Some show regular lobulated nuclei, while others show only a round nucleus. The cytoplasm is enormously enlarged and seems to be vacuolized. The nuclei have little chromatin and the cells have the appearance of balloons. Some bacteria are seen in the neighborhood, and in the cytoplasm of the well-preserved cells. Smears from the caries-immune contain comparatively few leukocytes. Those present are markedly degenerated. (Fig. 9.) The three cells in the central portion of Figure 9 are difficult to recognize. Very little cytoplasm can be seen. The nuclei are enlarged, but their chromatin is stained.

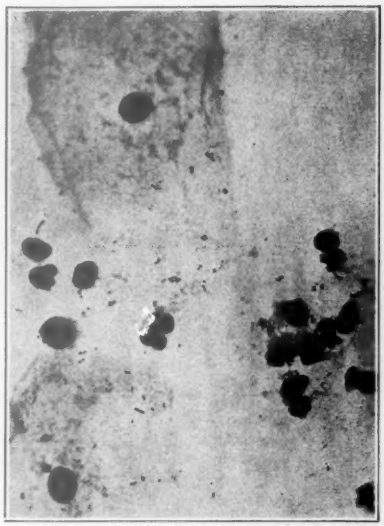

Fig. 10.—Smear from caries-susceptible mouth. The epithelial cells are relatively free from bacteria and there are a large number of leukocytes present. (×800.)

The cell in the upper left hand corner of Figure 9 is enormously enlarged and there are vacuoles in its cytoplasm and nucleus. The cell in the lower right hand corner of Figure 9 resembles a mononuclear non-granular leukocyte. Lymphocytes are present in very small numbers. Groups of leukocytes, as seen in Figures 7 and 8, appear mostly in the saliva of the caries-susceptible.

In the caries-susceptible cases, one sees

a large number of leukocytes arranged in groups and in relatively good condition. The nuclei are well stained and lobulated. Bacteria are incorporated in the cytoplasm in some places. The number of epithelial cells is very limited, and they are usually present as single cells with only a few bacteria. (Figs. 10 and 11.)

In two cases of caries susceptibility, a remarkable picture was seen. There were almost no leukocytes in the saliva, but there were large numbers of epithelial cells. These epithelial cells showed almost no bacteria. (Fig. 1.)

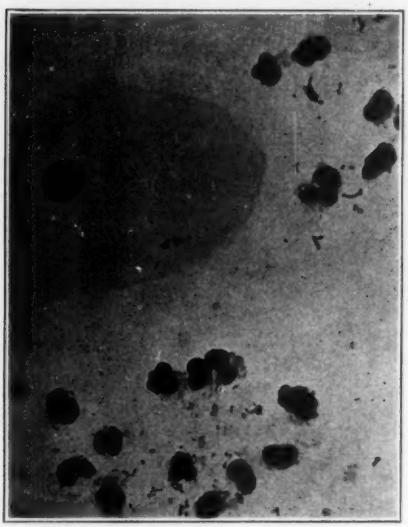

Fig. 11.—Specimen of saliva from caries-susceptible mouth. There are a large number of leukocytes. The epithelial cell shows few bacteria. (×1,000.)

In caries-immune cases, the saliva is characterized by a large number of epithelial cells in small or large groups which are overgrown by bacteria. The number of leukocytes is small. They are seldom found in good condition, and degeneration is usually far advanced. (Fig. 9.) Good examples of the general impression of caries-immune cases are seen in Figures 12 and 13. In Figure 12, four epithelial cells and two degenerated leukocytes are seen. In Figure 13, two epithelial cells overlapping each other and a nucleus of an epithelial cell without visible cytoplasm are present. One of the epithelial cells is filled with bacteria; the other shows relatively few. In the lower left hand corner of the picture, one can see a nucleus of a leukocyte.

Fig. 12.—Smear from saliva of caries-immune mouth. There are a relatively large number of epithelial cells as compared with the leukocytes and they are covered by microorganisms. The leukocytes (a) have degenerated. (×1,000.)

COMMENT

Comparatively little consideration has been given to the cytology of saliva in dental literature. This may be due to the fact that this subject did not seem to fit into any branch of dental research. The histologist and pathologist were mainly interested in the structure

of the dental tissues and its changes. The chemist studied the composition of the teeth and saliva, as well as chemical changes due to various conditions. The bacteriologist was mostly concerned with the organisms found in the mouth. The cytology of the saliva was the stepchild of dental research.

We have described different types of cellular elements in saliva, as far as we could distinguish them with our routine method. We are fully aware of the difficulties facing us in this problem. There seem to be many factors in the number of leukocytes in saliva. The number may vary during the day. It may be influenced by diet, sleep, work or oral and general health. The physical and chemical changes in the saliva during the day may affect the number and condition of the cells present in the saliva. The presence and condition of the epithelial cells and bacteria in saliva may also be affected by these conditions. Epithelial cells may be removed from the mucous membrane in greater quantities by coarse food than by soft food. Bacteria of certain types may proliferate with greater ease in saliva that contains many epithelial cells, in immune cases. There were comparatively few associated with the epithelial cells in the caries-susceptible. In spite of the many varying influences described above, it was possible to diagnose, from the smear, the type of individual from which it was obtained. The same individuals have been tested several times, and the pictures obtained revealed a remarkable similarity when they were obtained under similar conditions.

Fig. 13.—Two epithelial cells from mouth of caries-immune person. The cytoplasm is overgrown by bacteria. (×1,000.)

This report of the relationship of the cellular elements in saliva must be considered as preliminary. Two findings require explanations and correlation. The first is the observation that there appear to be a larger number of bacteria associated with the epithelial cells in the immune cases than in the susceptible cases. It has been stated that cultures of bacteria from saliva on a medium favorable to aciduric organisms (tomato-agar) will generally show a higher number of colonies in caries-susceptible cases than in caries-immune cases. The reason for this seeming difference between the bacteriologic and histologic findings may lie in the fact that in tomato-agar culture, we cultivate aciduric bacteria, while the bacteria in our specimens on the epithelial cells may be proteolytic.

Without cultivating and special staining methods, we cannot determine the type of bacteria attached to the epithelial cells. They might belong to *Micrococcus catarrhalis, Staphylococcus albus* and *Streptococcus viridans* types as far as we could identify them from their morphologic appearance in our specimens.

The second finding concerns the presence of more leukocytes in the saliva of

caries-susceptible cases than in the caries-immune. Former investigations have shown, as previously stated, that there is more proteolytic enzyme in the saliva of the caries-immune than in the saliva of the caries-susceptible. No definite correlation between the amount of enzyme and number of leukocytes was found. It was supposed that the activity, rather than the number of leukocytes, was responsible for the production of enzyme. The present study indicates that the activity of the leukocytes in enzyme production may be questionable. Some enzyme may be liberated by the degenerating leukocytes. The main source, however, seems to be associated with bacterial activity.

The larger number of leukocytes in the saliva in caries-susceptible cases may be explained by a positive chemotaxis of the saliva or aciduric organisms on the leukocytes. A chemotaxis of saliva was demonstrated by Dietz.[16] These facts may indicate that irritation of the mucous membrane, caries or restorations with gingival discrepancies may cause a leukocytosis. One might expect to find fewer leukocytes in caries-susceptible cases in which these factors were not present. The smaller amount of proteolytic activity in the saliva of the caries-susceptible may be explained by the comparative absence of leukocytes or of bacteria with proteolytic activity.

The leukocytes of the saliva are of varying shape and size, as already stated by different investigators. This is due to the fact that the leukocytes, migrating from the capillaries of the submucosa onto the surface through the meshwork of epithelium, undergo changes due to the changes in the environment. This change in environment may be a change in the pH reaction, or other physical and chemical conditions. Von Recklinghausen[17] (1863) stated that the difference in the leukocytes of the blood and those of the saliva may be due to the difference in "concentration" of the fluid wetting the surface of the mucous membrane. Recently, Menkin[18] reported changes in the leukocytes due to changes in the hydrogen-ion concentration *in vitro*. An acid reaction of pH 6.6, or thereabouts, she found to be deleterious to polymorphonuclear leukocytes.

Laquer[19] states that the leukocytes become changed and swollen in the saliva because this medium is hypotonic. The nuclei become fused and lose their lobulated appearance. The same statement was made by Isaacs and Danielian,[13] who found that the leukocytes may live a few hours in the saliva and undergo a certain change in the death process. The cell becomes larger, the granules become less distinct and the nucleus appears rounded, with the loss of some or all of the lobulations.

Lymphocytes were seldom found. Weidenreich[20] asserted that the leukocytes in saliva originated from the lymphatic organs of the throat and changed into leukocytes in the saliva. Laquer,[19] as well as Hammerschlag,[21] denied this possibility and stated that the leukocytes migrated from the blood vessels as leukocytes.

SUMMARY

1. The cellular elements of saliva are composed of epithelial cells and leukocytes.

2. The epithelial cells, as well as leukocytes, were found well preserved or in different stages of disintegration.

3. The relationship of epithelial cells, leukocytes and micro-organisms was studied in caries-free and in caries-susceptible persons.

4. In the saliva of the caries-immune, there were relatively more epithelial cells and fewer leukocytes than in the saliva of the caries-susceptible.

5. In caries-immune saliva, the epithelial cells were covered by micro-organisms. In susceptible cases, they were relatively free from bacteria.

6. In caries-susceptible saliva, the leukocytes were found in a relatively better condition than in the saliva of the immune.

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ECONOMICS AS RELATED TO DENTISTRY FOR CHILDREN

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THE practice of dentistry for children has been disliked for the most part in the past because it has not been financially interesting. The fault has not been entirely with the people who do the paying, but, in a large measure, with the individual dentist. There are certain fundamentals of business that one must consider, and if these are not incorporated in practice, failure is definitely invited. The first of these factors, and one frequently neglected, is the method of making appointments.

APPOINTMENTS

Every practitioner should adhere to an appointment schedule in order that he may evaluate certain pieces of work, as well as maintain efficiency in the office. It has been a common practice, and still is in some offices, to have the patient come in for her 3 o'clock appointment to set an inlay, bringing one or two of her children to have their work done at the same time. She says, "O Doctor, I thought you could fill this aching tooth for Jimmie before you see me today. You see it's only a baby tooth and it won't take many minutes." In many offices little Jimmie is directed to the dental chair, and the dentist in a very hurried manner and with a disgusted attitude will wipe a bit of cement into the cavity; whereupon the mother remarks, "Are there any charges for fixing Jimmie's tooth?" The dentist who practices children's dentistry in this way often says, "I guess 50 cents will be all right." In this case, the dentist, the patient and the parent were all cheated, for it is impossible to attain a sound financial basis via such an approach to the patient.

This dentist could have said, "I shall be very glad to relieve Jimmie of the toothache, and I shall place a temporary treatment in his tooth until we can arrange for a definite appointment. You see, Jimmie must retain this deciduous tooth for chewing for several years, and, too, if he should lose a deciduous tooth too early, it will mean the loss of space, which may cause the teeth to become crooked. I should like to examine his teeth thoroughly and to discuss his dental problems with you at a convenient time in the future."

Mrs. Smith must be "sold" on dental care for children, and the time to convince her is on Jimmie's first appointment, and certainly not at the time allotted for her work.

The number of appointments per year after the work in the mouth has all been completed will vary with the individual case. However, an appointment approximately every four months will be sufficient in the average case.

The initial appointment should always include a thorough examination. Success or failure may be invited at the

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time of the examination; for without a thorough knowledge of the case, a satisfactory and adequate diagnosis cannot be made. A large percentage of patients walk out of the office because sharp explorers and the x-rays have not been employed.

After he has made a complete check of the mouth, the dentist should review the entire case with the parents. The mother and father are always interested in the number of cavities and the extractions probably necessary in the child's mouth. Sometimes, the serious mistake is made of starting a case before consultation with the parents. A question or doubt may enter the mother's or the father's mind as to what work is really necessary in the child's mouth, and if they are in this frame of mind, payment of the dental bill may be delayed.

The preschool child is the one for whom the most good can be done, since a large percentage of decay is usually evidenced before the first day in school. Entire mouths have been wrecked before the age of 5, and many extractions are in evidence by the fifth birthday. It is at this very important time that an active parent-teacher association can do much good in a community. An ever-increasing activity of the public health dental educator, through the various departments of health, can do much to promote earlier care of the deciduous teeth. The greatest effort should be directed toward this preschool group, so that when the child reports to the classroom, there will be no physical deficiencies in and about the mouth.

The various phases of the appointment having been considered, it is now in order to review some of the factors in the success or failure of dentistry for children: (1) the presentation of children's dentistry to the patient and the parent; (2) the examination; (3) the financial arrangement; (4) the record; (5) operative procedure, and (6) child management.

THE PRESENTATION TO THE PATIENT AND PARENT

It has been the belief among those in the dental profession that dentistry for children could not be economically sound. The majority of offices have had their figures on the red side of the ledger. A common expression among the general practitioners has been, "My patients won't pay for children's work," or "My town is different." The fault in all cases is certainly not with the people of the particular town or city, but much or at least some of the blame for the situation can be laid directly at the feet of the individual dentist. There are some persons in every town or city, regardless of the size of the community, who want their children to have the best type of medical and dental service, and these persons can pay for it. One of the chief reasons why some practitioners do not insert more gold inlays, the better dentures or space retainers is that they do not offer this service to the patient. A salesman for any large industry would starve to death if he went about in a negative frame of mind or tried to sell a customer something with which he was not very familiar. In the past, it was considered unethical to think and talk in terms of salesmanship, but, when the situation is really analyzed, it becomes evident that dentistry must be "sold," and the practitioner who can best and most convincingly present his story is the one who will do the majority of work and for the highest fees. If a patient realizes the true value of health and how when it is once lost, no amount of money can rebuy it, then and then only will the dentist's services be appreciated. If the practitioner can describe in a convincing way or visualize for a parent the true significance and value of deciduous teeth to health and future happiness, the problem of financial return for the necessary work will be materially lessened.

It is true that many parents anticipate

a remark of "no charge" from the dentist, and for this reason much of the dental work in the mouths of the children has been of a "no charge" quality. It is not necessary to be a high pressure salesman or to wear the right kind of tie to "sell" dentistry for children. All that is necessary is to have an understanding of the fundamental principles of children's work and then, in a logical way, present the problem to the parent. One of the requisites is that the dentist himself be thoroughly convinced of the value of the service he wishes to render the young patient.

It is highly desirable and practical to illustrate the varied problems and restorations to the patient and the parent by the medium of models and x-ray pictures. Charts have been found very beneficial in telling the story. One minute's illustration with a model can many times do more than an hour's talk, which may not be understood by the patient or parent. An impression in compound, or another material of choice, can easily be taken of interesting and representative cases and plaster models be made of them. These are inexpensive and will serve as an excellent means of approach in the demonstration to parents of the various types of cases. Commercial models may also be used on which may be demonstrated various types of restorations.

THE EXAMINATION

The value of an adequate examination cannot be overemphasized. The practice of spot filling, meaning the treatment and restoration of one tooth without due consideration of all the remaining teeth and the mouth as a whole, certainly invites failure. A comprehensive examination normally should be made at the first regular appointment and all of the factors in the case should be considered.

A disregard for the detailed inspection of the mouth will often lead to much embarrassment and professional humility. Filling a deciduous tooth without regard to the patient's age has often invited criticism. Likewise, the extraction of a deciduous tooth without due consideration for its permanent successor has frequently led to trouble.

It is impossible to present to a parent the true picture or perspective of the child's mouth unless every possible avenue of examination has been explored. It is only by obtaining a complete record that a suitable and equitable financial arrangement can be made with the parent and a definite fee be arrived at that will cover the case. The financial road in dentistry is too hazardous to play with uncertainties and to gamble with a questionable diagnosis. Once a fee is quoted to a parent, the case should be completed to the best of the operator's ability. If additional cavities are found or an unexpected condition arises, the dentist should assume the blame for its correction. Enough time should be reserved at the initial appointment to allow for a complete examination. A few extra minutes in the careful inspection of a mouth may mean the saving of several hours of non-pay work later.

FINANCIAL ARRANGEMENT

There should be no hesitancy on the part of the dentist to discuss the financial arrangements for a particular case. The parent, the financially interested party in dentistry for children, has been thinking in most instances of the monetary consideration before bringing the child to the dental office. The father or the mother is very much interested in what it is going to cost to have the dental work completed. The dentist in some instances has been shy, indifferent and non-exacting in the vital point of interest to the average parent. Frequently, practitioners have sacrificed their time and effort in care of the child patient and have

given away their services. If the dentist sincerely feels that he is rendering a service when dealing with that mother's and father's most prized possession, their child, he should not hesitate to ask a reasonable reward for his time and services.

It is with these thoughts that a thorough examination is completed, and then, turning to the parent, the dentist may say, "I know you will be interested in checking Mary's mouth with me so that you may see all the work to be done." He then may say, "You probably would like to know something about the cost of the work also, and the financial arrangements customary in this office."

One does not have to be bold or discourteous in making these or similar remarks, but should allow the parent to express himself definitely after he understands the financial arrangement. When dentist and parent understand each other and agree on some plan for payment, the work may proceed upon a sound basis.

The dental office is no different from any other business with reference to overhead or in the selling of service. An hour spent with the child in the chair is just as valuable in terms of service as any hour ever spent with an adult. There should be no differentiation in the fees on an hourly basis between the child and the adult. In most instances, one may not receive so much for Class II or Class I fillings in the deciduous dentition, but the reason should be that the work can be done more rapidly than in the adult tooth, and not because it is a child's tooth.

The question has often been asked, "How can I practice dentistry for children and obtain a reasonable fee for my services?" This issue must be judiciously considered in every office. Time, in terms of service, is the only thing that a dentist can logically sell. His overhead is based on the time element, and each practitioner must make his estimates on the basis of what it costs him to operate an hour. It is not reasonable that a dentist should work ten or twelve hours a day in the office just to cut down the cost per hour to his patients, but this is exactly what some men are doing. This type of practice will ruin the dentist physically, professionally and financially in a comparatively few years. A man broken in health and spirit will no longer be respected, and the dentist will no longer be patronized by his former patients.

A reasonable number of hours, not to exceed eight, can rightfully be spent in the office, and, upon this basis, or a lesser number of working hours, the cost of one's service can be estimated. The really productive time, however, is that spent in actually working at the chair, and it therefore does not include all of the time spent in the office.

Having arrived at the average number of hours one actually works at the chair, and, too, the gross overhead a day, as well as allowing a reasonable salary or profit, one can give a fairly accurate estimate to patient or parent.

It is not practical or wise to talk in terms of so much an hour in discussing a fee, because the average patient will not understand, and the dentist would be considered unreasonable if he spoke in terms of $6, $8 or $10 an hour. Most practitioners know, however, approximately how long it takes them to fill a particular type of cavity or a root-canal or to make a space retainer, and, from this evaluation of the probable time, can make a fairly accurate estimate of the total bill. The important thing is to have made a very careful examination and diagnosis, for without this background, the quotation of any fee would be guesswork.

The dentist who knows and understands that the parents are informed as to the necessary dental work and that the financial arrangements have been

made can proceed with a clear mind to give the best type of service for the child. There is an appreciable lack of interest in a case in which the fee question has not been settled, and both the patient and the dentist will lose in this instance. There is no reason why the question of fees should not be settled at the initial appointment.

THE RECORD

An adequate record entails the recording of all the findings in the examination with supplementary notes that may have a bearing on the case. It also means the correct filing of the charts, roentgenograms, models and any data of direct interest. The financial arrangements should be in writing on the chart so that this phase cannot be questioned.

A complete record has proved valuable in many instances in courts. A dentist without these would be severely handicapped in the event of a lawsuit. This negligence has cost dentistry vast sums of money.

A good record also allows the dentist to retrace his operative steps when necessary, and also to determine the practicability and serviceableness of the dental work completed some time previously.

It costs little to have a complete record and it frequently saves so much that the successful practitioner will not want to be without it.

OPERATIVE PROCEDURE

The success or failure of any dentist financially can, to an appreciable degree, be measured in terms of operative skill. One must possess a reasonable amount of digital dexterity if success is anticipated. Poor work in terms of unsatisfactory results cannot be overshadowed by a highly pleasing personality or personal appearance. A strong, positive personality is highly desirable and, coupled with operative skill and good judgment, assures a most favorable final result. A good operator with just an average personality will be more successful than the poor operator with a "high-powered" personality.

The practice of dentistry for children has become an essential in every general practice and it should not be drudgery. Volumes have been written concerning child psychology and some would have us believe that it is necessary to have a master mind to cope with the child. Ordinary, everyday judgment, with a bit of application, is all that is necessary, and any one who has the desire to understand the child will have little difficulty. It is not necessary that one know all of the fairy tales, nor does one have to spend one-half to three-fourths of the appointment time playing or making funny faces at the child. A normal boy or girl does not expect or really want this type of demonstration, and the dentist who spends most of his time pumping the prospective patient up and down in the dental chair is largely defeating his purpose. It is true that the mother and father may stand by and enjoy seeing one spend so much time amusing the child, but they certainly will not react pleasantly when a financial reminder is sent them. Time is money in a dental office just as it is in any business, and the overhead goes on and on all during the time one plays with the child. It is good business to be polite and courteous, and a reasonable amount of time can profitably be spent getting acquainted with the child, but there is a limit to non-productive time.

It is not necessary that one love all children to be successful in this branch of dentistry, for there are comparatively few persons capable of loving every child. It is, however, necessary that one have the desire to serve the child, and if the operator can see in the future a satisfied patient that will continue to be a patient for years to come, there is a definite incentive to master the present situation. Then, too, if a dentist can visualize

a growing, developing child that really needs his services, and recognizes that he as a dentist can have a small or a large part in the success, health and happiness of that individual for life, a second incentive arises to inspire that dentist to give his best.

Contrary to the foregoing desires and ambitions, if the dentist sees only another "brat" coming into his office, and a patient whom he will get rid of just as soon as he can, the dental work done for the child will compare favorably with these reactions. Such a dentist is looking through smoke-colored glasses, and his success as a professional man will be questionable.

The least that any practitioner can do if children are not welcome in his practice, or if he is temperamentally unsuited to their work, is to refer them to a competent colleague. It is not a disgrace to admit deficiencies or preferences in work, but it is unprofessional and a violation of the code of ethics not to refer a case that is in need of service if one does not desire to accept the responsibilities of the case.

As regards the behavior problems, there are certain factors in the child's life and physiologic makeup that are responsible in a large measure for its attitude. The factors that one must consider with reference to child psychology and their relationship to the dentist are as follows: (1) the age of the child; (2) the home environment; (3) school and childhood associates; (4) health; (5) inherent characteristics, and (6) the dentist (appearance, office, etc.).

Considerable time could well be spent discussing each of these six points. The various types of children and their respective behavior problems have been most ably discussed by Drs. Lamons,[4] Easlick,[2] McBride,[5] Hogeboom[3] and others, and a review of these papers will well repay the reader for his efforts.

In the building of a children's practice, the question is asked many times, "Do I as a general practitioner need a child's dental chair, a unit and a separate operating room for children?" The answer is definitely, "No." One may render just as complete service and do just as fine work in an adult chair in a common operatory as is possible in the specially designed office. There is no doubt, however, that a child's chair and a room especially prepared for children add a psychologic advantage in some cases. How much this psychologic advantage is worth in actual dollars is questionable.

The prophylactic call list is one of the very effective means of retaining patients as well as keeping a checkup on the dental and physical condition of the patient at regular intervals. It is suggested that, as soon as all of a patient's work is completed, the dentist recommend a regular checkup and call for prophylaxis. He may say to the parent, "All of the necessary dental work is now completed in Mary's mouth, and, if you like, I can place her name, as I do with many others, on my regular prophylactic call list. Mary will be called or notified in four months that it is time for a prophylaxis, and at that time I shall again thoroughly examine her mouth and teeth to note any changes; also to see whether all of my present work is satisfactory."

Such a call list will afford one an excellent opportunity to be busy at all times, and when this method is followed for a few years, the recall list from month to month will be a great item in the stabilization of a practice.

Dentistry for children is primarily for the general practitioner, and it is in his office that this important branch of dentistry must succeed. A practitioner, in order to be successful, must be cognizant of several important factors in success. These are complete, detailed examination, correct diagnosis and prognosis,

reasonable operative skill and adequate financial return for the services rendered.

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NEW CULTURE METHOD FOR DENTAL BACTERIOLOGY

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THIS paper is presented to describe the technic and show the value of a new method for culturing bacteria, and to show the application of this method to the field of dental bacteriology.

Known as a "serial dilution culture method," this technic was developed by E. C. Rosenow in the Laboratory for Experimental Bacteriology of The Mayo Foundation. The work was undertaken at Dr. Rosenow's suggestion, using his dilution culture technic.

We believe that this method is of value in either ruling out, or determining the extent of, contamination which can be attributed to contact of the apical portion of a tooth with the tissue of the gingival crevice or mucous membrane of the mouth during extraction.

The tooth from which the apex was to be removed for culture was isolated from the rest of the mouth by placing sterile gauze over the adjoining teeth and mucous membrane. The tooth and its adjacent mucous membrane were swabbed with 3 per cent tincture of iodine, care being exercised to introduce the iodine into the gingival crevice. After one minute, this procedure was followed by the introduction of a solution of 70 per cent alcohol. The entire procedure was then repeated.

After the region had been twice treated with iodine and alcohol, it was dried with a sterile cotton swab. Next, a sterile, dry swab was wiped over the mucous membrane about the neck of the tooth, and an attempt was made to contact the gingivae in the same regions through which the apex of the tooth would pass if it happened to touch the mucous membrane during extraction. This swab was placed in a sterile test tube holding 2 cc. of Locke's solution containing 0.2 per cent gelatin. The contents of this test tube were considered to be our control.

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In six instances, apices of vital teeth the periodontal tissues of which were free from gingivitis and pyorrhea were used as controls in evaluating results obtained from cultures from the apices of pulpless teeth.

The tooth was then extracted with sterile forceps. The apex, 3 to 4 mm. in length, was cut off with sterile biopsy forceps so that it fell directly into a tube holding 2 cc. of Locke's solution containing 0.2 per cent gelatin. This solution, after agitation with the severed apex, was used as the inoculum. Cultures were made routinely within from one to three hours after extraction of the teeth used.

Three types of media were used routinely in this study: (1) blood-agar plates; (2) dextrose-brain broth (0.2 per cent dextrose in tall column), and (3) dextrose-brain-agar (0.2 per cent dextrose and 0.2 per cent agar), likewise in tall columns.

The inoculation of these media was done in a bacteriologic non-ventilated hood in which the heat from the Bunsen burner is dissipated by a copper roof. Previous to inoculation of the media, the walls of this hood were washed with a 1:1,000 solution of phenyl mercuric chloride and the air within the hood and the walls was sprayed with a saturated solution of phenyl mercuric chloride.

For each dilution culture, fourteen tall tubes of dextrose-brain-agar were employed. Each tube contained 18 cc. of this medium. The agar in these tubes was melted by steaming the tubes in an autoclave and then allowing them to cool to a temperature of 40° C. (104° F.). The dextrose-brain-agar was especially

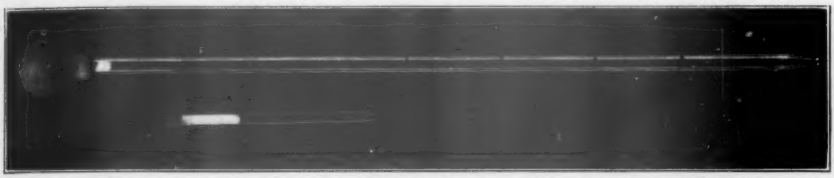

Fig. 1.—Fine capillary tube of type used to withdraw individual colonies of organisms from dextrose-brain-agar for study. The larger pipet with a rubber bulb is the type used to make serial dilutions in dextrose-brain-agar.

Fig. 2.—Dilution culture grown from washings of apical end of pulpless tooth. Discrete colonies of organisms have appeared in dilution 10^{-12} and dilution 10^{-14}. Colonies appearing in lower dilutions were too numerous to show clearly in the photograph.

advantageous as a medium, in that it was sufficiently firm at 35° C. (95° F.) for the colonies to remain discrete, so that they could be counted and studied individually.

These fourteen tubes were placed side by side in a rack and were labeled according to the dilution of the material with which the medium had been inoculated. A small graduated pipet was fitted with a rubber bulb. (Fig. 1.) With this pipet, 2 cc. of solution was taken from the tube containing the material to be cultured. This solution was inoculated into the first of the fourteen tubes of melted agar, care being exercised to deposit at least a portion of the inoculum in the lower part of the tube, where a lower oxygen tension exists. The content of the tube was thoroughly mixed by alternately pressing and relaxing the rubber bulb, care being exercised not to force air into the lower portion of the tube, since such action would disturb the anaerobic conditions present, at least temporarily.

The first pipet was withdrawn empty from the agar tube, and was discarded. This was done to eliminate the possibility of carrying organisms past a number of tubes and finally depositing them in a tube of higher dilution, a procedure that might result if one pipet were used to inoculate all the tubes. Such action might lead to an erroneous interpretation of results.

A second sterile, graduated pipet was

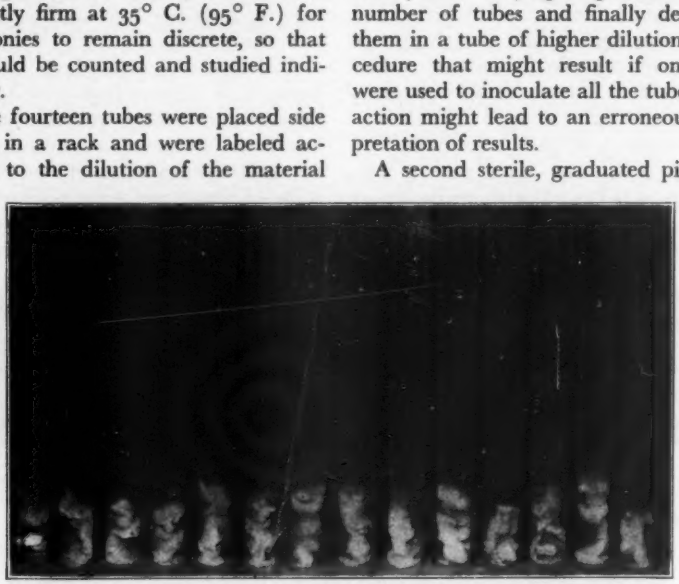

Fig. 3.—Typical set of serial dilution cultures of washings from apical end of vital tooth. The first two test tubes at the left each have one colony of micrococci. All the higher dilutions are free from colonies. The white substance in the bottom of the tubes is fresh calf's brain and a few chips of marble, added before autoclaving. The brain substance maintains anaerobic conditions at the lower end of the tube, and the marble checks the pH of the medium.

TABLE 1.—RESULTS OF DILUTION CULTURES, WASHINGS FROM APICES OF THIRTY-SEVEN PULPLESS TEETH IN WHICH CONTROL SWABBINGS WERE NEGATIVE

Dilution	Number Showing Growth	Per Cent Showing Growth	Colonies, Average Number
10^{-1}	37	100	*
10^{-2}	36	97	*
10^{-3}	30	81	60
10^{-4}	23	62	42
10^{-5}	18	49	14
10^{-6}	12	32	4
10^{-7}	9	24	4
10^{-8}	5	14	5
10^{-10}	4	10	5
10^{-12}	3	8	5
10^{-14}	3	8	5
10^{-16}	2	5	2
10^{-18}	1	2	7
10^{-20}	2	5	4

*Colonies too numerous to permit accurate counting.

quickly adapted to the rubber bulb, and 2 cc. of material was withdrawn from tube 1 and inoculated into tube 2. Pipet 2 was in turn discarded, empty, and the same procedure was repeated for each tube, the pipet being changed for each inoculation made. After inoculation of tube 8, the remaining six tubes were inoculated with only 0.2 cc. of material, instead of 2 cc., with which each of the eight preceding tubes had been inoculated. This procedure produced a dilution of 100 times, rather than ten times, in each succeeding tube.

The last six tubes were labeled 10^{-10}, 10^{-12}, up to and including 10^{-20}. The inoculation of fourteen tubes required about five minutes, or approximately twenty-one seconds for each tube. When all fourteen tubes had been inoculated, the rack containing them was placed in the incubator at 35° C. (95° F.).

To check the technical procedure of making cultures, similar dilutions were made by transferring sterile gelatin and Locke's solution, an action that was always attended with negative results.

Several drops of the original culture material from the gelatin-Locke's solution was spread on the surface of a blood-agar plate. This material was likewise incubated and examined at the end of twenty-four and forty-eight hours. Cultures made on blood-agar nearly always yielded negative results. On several, a few colonies appeared, usually of green-producing streptococci.

The remainder of the original culture material, including the apex of the tooth, was placed in a tube of dextrose-brain broth and was incubated for twenty-four hours, at the end of which time a smear was made to determine the identity of the organism. The dextrose-brain-agar dilution cultures were examined at twenty-four-hour intervals for three days, and records were made of the number of colonies which appeared. At the end of three days, very finely drawn pipets were used to remove colonies from the various dilution tubes for identification. (Fig. 1.) Some of these colonies were subcultured in suitable media for further study.

The organisms found in the low and

Fig. 4.—Photomicrograph of streptococci obtained from single colony of dextrose-brain-agar in dilution of 10^{-14}, as indicated in Figure 2. The typical shape and relatively larger organisms in diplo-chain formation are depicted. (Gram's stain; × 1,000.)

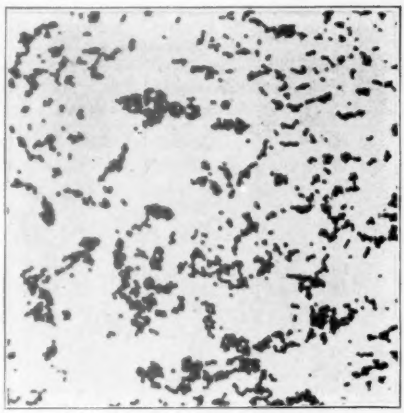

Fig. 5.—Photomicrograph of micrococci obtained from control dilution of 10^{-2}, as shown in Figure 3. The organisms are small and round and have a clumped arrangement. (Gram's stain; × 1,000.)

high dilutions in dextrose-brain-agar and in dextrose-brain broth of the material from the apices of pulpless teeth were nearly always short-chained streptococci, which produced green similar to that of *Streptococcus viridans* or the alpha type of hemolysis seen on blood-agar plates.

Streptococci from the apices of pulpless teeth and granulomas were found to be either anaerobic or partial-tension organisms in the primary culture because growth of the cultures on aerobic blood-agar plates was nearly always negative or else resulted in the appearance of only a few colonies. Repeatedly, when washings spread on blood-agar plates showed no growth, countless numbers of colonies grew in the 10^{-1} dilution in dextrose-brain-agar when the dilution was inoculated with identical washings. (Figs. 2 and 3.) The predominating organisms found in the control test tubes were relatively small numbers of colonies of staphylococci, together with small elongated streptococci, mostly in long chains, and a few gram-negative bacilli. (Figs. 4 and 5.)

Of sixty-three control swabbings, only twenty-six yielded diffuse growth in dextrose-brain broth and relatively small numbers of colonies in dextrose-brain-agar. Four of six apices of normal vital teeth yielded growth in dextrose-brain broth, and five yielded a few colonies in dextrose-brain-agar which were taken to represent contaminations.

For purposes of classification in this study, those non-vital teeth showing no changes in the dental roentgenogram were classed as "roentgenologically negative." Those teeth showing some deviation from normal in the roentgenogram were classed as "roentgenologically positive."

All cultures in dextrose-brain broth and dextrose-brain-agar of the apices of sixteen roentgenologically negative and of forty-five roentgenologically positive non-vital teeth, and of eleven granulomas, yielded streptococci, which were always in either pure or nearly pure cultures. Countless numbers of colonies grew in the 10^{-1} dilution in dextrose-brain-agar in each instance.

Table 1 shows the results of the dilution cultures in dextrose-brain-agar of

TABLE 2.—RESULTS OF THIRTY-ONE DILUTION CULTURES GROWN IN DEXTROSE-BRAIN-AGAR WHICH HAD THIRTY-ONE POSITIVE CONTROLS

Dilution	Cultures			Controls		
	Number Showing Growth	Per Cent Showing Growth	Colonies, Average Number	Number Showing Growth	Per Cent Showing Growth	Colonies, Average Number
10^{-1}	31	100	*	31	100	*
10^{-2}	30	97	*	25	81	*
10^{-3}	30	97	90	19	61	63
10^{-4}	25	81	43	11	35	61
10^{-5}	20	65	16	8	26	8
10^{-6}	18	58	20	4	13	2
10^{-7}	15	48	7	2	6	2
10^{-8}	13	42	10	1	3	1
10^{-10}	8	26	3	0	0	0
10^{-12}	6	19	3	0	0	0
10^{-14}	6	19	14	0	0	0
10^{-16}	3	10	2	0	0	0
10^{-18}	2	6	2	0	0	0
10^{-20}	1	3	1	0	0	0

*Colonies too numerous to permit accurate counting.

the washings from the apices of thirty-seven pulpless teeth in which the control swabbings were negative.

All cultures from the apices of pulpless teeth and the positive controls revealed innumerable colonies in dextrose-brain-agar in the 10^{-1} dilution. There was a gradual decrease in the number of colonies in the cultures from the apices of pulpless teeth as the dilutions increased. In some, colonies grew in dilution as high as 10^{-20}. This was in sharp contrast to the sudden decrease in the number of colonies in the controls, none of which grew in a dilution greater than 10^{-8} (Table 2).

The controls of this group were from teeth removed where gingival conditions made sterilization impossible. The value of this method lies in the possibility of evaluating surface contamination, since the great majority of teeth extracted have some degree of peridental involvement.

SUMMARY AND CONCLUSIONS

1. The dilution culture method is of use in evaluating surface contamination when teeth removed by simple extraction are to be cultured.

2. A comparison of the cultures of the pulpless teeth showed no significant difference between the roentgenologically positive and roentgenologically negative teeth.

3. Pure strains of organisms may be isolated by the serial dilution culture method, and organisms having the greater "growth pressure," which are most suitable for vaccines, injection of animals and agglutination tests, may be selected.

4. The number of cases reported is as yet too small for definite conclusions. The dilution culture method is submitted in the hope that it may be used by others in the field of dental bacteriology.

THE FULL DENTURE: A BIOLOGIC ANALYSIS OF ITS FORM, FUNCTION AND STABILITY

By DOROTHY B. WAUGH, D.D.S.,* Philadelphia, Pa.

A KNOWLEDGE of the structures of the mouth and their effect upon the stability of a denture, and some conception of what occurs beneath the plastic material on an impression tray, would seem to be the first consideration in denture construction. A digital examination of the mouth will reveal the strength and extent of muscle attachments, the character of the soft tissues covering the alveolar ridges, the bony landmarks of maxillae and mandible and the approximate surface area to be covered by the dentures.

Secondly, there should be recognition of the fact that impressions of the soft tissues and musculature of the mouth in a state of rest will produce dentures that will be acceptable to the mouth in quiescence. But the cavity of the mouth is the scene of constant activity, the soft undulating surfaces of lips, cheeks, tongue and floor of the mouth providing multidirectional waves of motion against two inflexible dentures, which may preserve equilibrium only when the mouth is quiet. If this statement is true, it must follow that any impression technic that does not include full muscular exercise

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must depend on other conditions to insure denture stability. Thus, dependence for retention on the artificial means of peripherally sealing dentures in the mouth, on balanced occlusion and on muscular support may suffice for all favorable cases, but all cases are not favorable, and it would appear to be good practice to build each and every case upon a true foundation.

As a third observation, it is noted that no two cases are exactly alike. Under these circumstances, each case becomes a specialty, an experiment or an adventure in prosthesis. It is this amazing fact of Nature which makes complete success in denture construction by no means a regular experience. Because of these dissimilarities, certain modifications in impression technics are indicated.

A fourth point concerns the coordination of this knowledge with the routine mechanical procedures of impression taking, which may be accomplished by charting each case graphically, or by memoranda. Building dentures to conform in every detail to the peculiarities of each case requires as much thought as it does manipulative skill, one effort being as important as another to the success of the work.

THE FORM WHICH THE DENTURE TAKES

Tissue Response to Denture Bulk.—This concerns a gradual muscular accommodation of the mouth to the form of the denture, occurring by an expansion of the muscles of a previously edentulous mouth or a draping of the muscles over the new outline of a remodeled denture. Tissue response to both weight and bulk is satisfactory provided other factors in denture construction are acceptable to the mouth.

Tissue Tolerance of Base Materials.—Tissue tolerance varies with the chemical composition and thermal conductivity of the material which covers the mouth. Base metals in minute quantities in denture alloys may act as an irritant to the delicate mucous membrane of the mouth. Similarly, certain patient idiosyncrasies

A Biologic Analysis of the Full Denture

The Form Which It Takes	The Function Which It Performs	The Stability Which It Possesses
Tissue response to denture bulk	Expression	Impression of the mouth in motion
Tissue tolerance of base materials	Speech	Muscle influence in the mouth
Tissue response to area covered	Prehension	Adaptation, adhesion, atmospheric pressure
Tissue preservation in tooth arrangement	Mastication	Correct incisal and occlusal planes
Clarity of speech in tooth positioning	Digestion	Spot grinding and milling
Structures of the Mouth	**Maintenance of Healthy Tissue**	**Destructive Processes of the Mouth**
Bones of the maxillae and mandible	Mouth hygiene	Bone resorption
Connective tissue and mucous membrane	Pressure stimulation	Tissue proliferation
Muscles of the mouth and face	Free circulation	Tissue atrophy
Blood vessels	Polishing dentures	Capillary strangulation
Nerves	Preservation of muscle tone	Muscular deformities

prevent the use of vulcanized rubber as a base material.

Tissue Response to the Area Covered.—The outline of the denture is predetermined by the active muscular boundaries of the mouth. The area covered is an important factor in denture stability, the degree of stability being proportionate to the amount of mouth surface included beneath the denture.

Tissue Preservation in Tooth Arrangement.—This will result from understanding of the physical principles of force, action and counteraction occurring during mastication, and the satisfactory dissipation of the effects of these forces by the arrangement of the posterior teeth with their axial planes paralleling the side of a triangle which has its apex in the skull, and its base on their occlusal planes. It concerns also the form of artificial tooth used, that form which permits the mandible to move freely in all its excursive movements.

Clarity of Speech.—This occurs when the upper central incisors have a satisfactory lingual form, when they are placed in correct vertical and horizontal positions and when the palatal form and thickness of the upper denture are such that the tongue meets none of the impediments of an unduly thick denture, excessive rugae carvings or short, non-anatomic lingual tooth forms.

THE FUNCTION WHICH THE DENTURE PERFORMS

Expression.—Prehistoric man showed only slight traces of facial expression, but with the evolution of the human face from coarse, wrinkled skin to the soft contours of facial muscles have come the apparent degenerative effects of civilized diet, depriving him of his teeth and making the preservation of facial expression of prime importance. A full complement of natural teeth framed in full gracefully curved lips beautifies the face, but the same face may assume a hard, cruel expression when the mouth becomes and remains edentulous or is imperfectly fitted with artificial teeth.

Speech.—Speech is articulate voice, perfected by the action of lips, mouth, tongue and teeth. The last-named is only subsidiary to the function of speech, but, without it, speech loses its fulness and clarity. Like expression, the phenomenon of speech has developed from a limited range of sounds to a perfection of tone highly specialized and reserved for man.

Prehension.—Prehension is an act which has evolved from the correlated use of eyes, hands and feet in the seizure and manipulation of food. As the primitive necessity for the seizure of food has ended, the function of prehension has lessened in importance, concerning the prosthodontist only so far as it becomes a factor of leverage in reducing denture stability.

Mastication.—Mastication with the artificial dentures concerns the effective comminution of food while preserving a functional balance of both dentures during the varied movements of the mandible. All variations in performance of this function signify individuality; therefore, the perfecting of masticating efficiency in the artificial dentures is brought about by no mechanical apparatus, but by specialized treatment of each individual case according to its specific needs.

Digestion.—The mouth is the beginning of the alimentary canal. The teeth are the means by which the food is first prepared for digestion. They are, in fact, the machinery of the digestive system, and, if satisfactory in numbers, form and function, they contribute very largely to the health of the individual.

THE STABILITY WHICH THE DENTURE POSSESSES

Impression.—A true impression of the mouth is taken in that state of full muscular activity occurring in speech, mastication, deglutition, expectoration,

coughing, yawning, singing, whistling and wind-instrument blowing; and that full freedom of the tongue and lips to perform such habits as licking of the lips and laving of the buccal and labial surfaces of the dentures with the tip of the tongue.

Muscle Influence in the Mouth.—A digital examination reveals the strength of the mouth muscles and indicates their possible resistance to a denture. Determination of the extent of their attachment aids in outlining the denture, to avoid displacement from overextension. Their adaptability to the new forms filling the mouth occurs by a gradual process of expansion, and a muscular draping over the buccal and labial surfaces of the dentures. The tongue that has spread in the mouth through the absence of teeth resumes its original form. Muscular balance or support of the dentures in the mouth is as important a factor in denture stability as is muscular balance to a dancer or trapeze artist—both occur by training. The removal of new dentures for rest or relief from pressure interrupts the gradual development of muscular balance. This phenomenon of muscular balance explains the successful manipulation of loose-fitting dentures within the mouth.

Adaptation, Adhesion and Atmospheric Pressure.—The denture base should be closely adapted to the mouth. Close adaptation results in satisfactory adhesion of two unlike surfaces; which, in turn, increases denture stability. Atmospheric pressure also plays a part in the physical retention of dentures. The denture base should cover the maximum area of the mouth without restricting those muscular movements described in "a true impression of the mouth." An irregular, undulating surface of the mucous membrane covering firm, healthy tissue is also a factor in denture stability, for it increases the denture-bearing area, and, by its nature, reduces the sliding motion of two opposing, slippery surfaces.

Correct Incisal and Occlusal Planes.—The ideal arrangement of artificial teeth follows closely that which existed in the natural denture, with particular reference to the occlusal plane, and affords a balanced occlusion which provides for a comfortable and easily obtained occlusal contact during the lateral and protrusive excursions of the mandible. Likewise, the incisal plane is established with proper respect for incisal contacts, which may, in protrusive and lateral positions of the mandible, serve to unseat the dentures if that incisal contact is not balanced by occlusal contact in the molar regions. The principles of leverage, of the second class, apply in this instance.

Spot Grinding and Milling.—After balanced occlusion is obtained on an articulator adjusted for the case, and accuracy in the mouth is checked, some spot-grinding may be necessary in the finished dentures; for the mechanical articulator does not provide for the resiliency of the mouth tissues and the discrepancy in occlusal contacts which must occur. Further balancing of the articulation is carried out several days after the insertion of the dentures by the use of an abrasive paste.

THE STRUCTURES OF THE MOUTH

Maxillae and Mandible.—The inherent susceptibility of the alveolar processes of the maxillae and mandible to recede after their function of supporting the natural teeth has ceased is physiologic rather than pathologic, but nevertheless makes satisfactory denture construction a biologic as well as a technical problem. There are, likewise, bone elevations and anomalies which further complicate the work, their surgical removal being accepted as good practice in furthering denture comfort and promoting a more satisfactory esthetic appearance. The quality of mixed bone found in the maxillae and mandible is particularly designed to meet the physical forces of mastication directed against it, the flat,

condensed outer layer receiving the load, the effect of which is dissipated by the underlying cancellous structure. The hard, outer layer also serves as an ideal anchorage in the torque and pull of the muscles of the mouth. A satisfactory mineral metabolism will keep balanced osteoblastic and osteoclastic action, normally occurring simultaneously.

Connective Tissue and Mucous Membrane.—The depth and distribution of the soft tissues of the mouth are as varied as its resiliency and its state of health; for example, we have the thin epithelial covering of a torus palatinus, the rounded bony protuberances of the alveolar ridge, the internal and external oblique ridges over which the soft tissue has a taut appearance, the loose fascia of the retromolar triangle and the dense but flexible tissue taking the place of the lost alveolar bone. A palate well padded with firm, healthy tissue provides an excellent base for a full denture, but the presence of a hard, bony palate thinly covered with connective tissue may result in rocking of the denture if this bearing area is not relieved. The extreme sensitivity of the soft tissues covering the mouth is evidenced by the painful and slow-to-heal abrasions caused by overextended dentures.

Muscles of the Mouth and Face.—The muscles of the mouth and face may be classified according to their effect upon the dentures: those that drape themselves around the dentures, such as the buccinators; those that exert pressure against the dentures, such as the cruciate muscles at the corners of the mouth; those that support the dentures, such as the tongue, and those that dislodge the dentures, such as the mylohyoids. To know well these muscles and the very important part they play in denture construction will lead to a precise outlining of the dentures to be built, as well as afford a means of diagnosing denture difficulties and correcting for overextension. They are the very active internal indicators of denture limits, the external expression of lack of dental care or improper construction of dentures.

Blood Vessels.—The vessels which emerge from the anterior and posterior palatine foramina are covered by a pad of connective tissue which is very often compressed through an impression technic which does not include relief at these three points. The familiar scalded appearance of the palatal tissue (capillary strangulation) is an indication that overcompression has occurred. The rôle which the circulatory system plays in the wearing of dentures cannot be ignored. It is an important biologic consideration, a link in the chain of principles and procedures by which dentures are scientifically constructed.

Nerves.—The nerves emerging from the palatine and mental foramina are the ones most concerned in this work. Although they provide no special problem in denture construction, there are frequent manifestations of nerve injury either from surgical operations, the trauma of a denture or the previous persistence of such diseases as pyorrhea alveolaris or gingivitis. This is evidenced by a needle-like pain on the buccal surfaces of the mandible or the crests of the alveolar ridges. Soreness of the soft tissues as from a bruise may be present, while the tissue itself may appear perfectly healthy. It is believed that pyorrhea alveolaris poisons the peripheral nerves of the soft tissues overlying the alveolus, thus causing denture discomfort. Concerning this condition, Dr. John A. Kolmer, professor of clinical medicine, Temple University, states:

> I think it is to be expected that the various streptococci, staphylococci and other organisms concerned in the etiology of gingivitis and complex periodontoclasia may produce neuritis or inflammation of these nerves either directly or through the agency of their toxins as part of the inflammatory changes. Fortunately, drainage is usually sufficient to prevent an ascending neuritis, which probably in part explains the absence

of neuritis or prompt recovery from it, but it is both possible and probable that in some instances a persistent and annoying neuritis may remain, proving troublesome from the standpoint of pressure by a denture, as well as from changes of temperature in the mouth.

THE MAINTENANCE OF HEALTHY TISSUE

Mouth Hygiene.—The maintenance of healthy tissue is promoted by cleaning the dentures daily, and periodically immersing them overnight in a borax solution, or any safe cleansing liquid. Owing to the self-cleansing nature of an edentulous mouth, it would seem unnecessary to perform any daily prophylaxis upon the mouth, such a regimen being one of personal cleanliness, and not altogether one of necessity.

Pressure Stimulation.—The presence of natural, healthy teeth in the alveolar sockets would appear to be the only reason for the existence of the alveolar bone; for, upon extraction of the teeth, this part of the maxillae or mandible is partially or completely resorbed. It is assumed that the presence of the tooth itself provides a certain stimulus to the alveolar bone, a physiologic process continuing until the tooth is lost. On insertion of a denture immediately after the extraction of teeth, the denture itself supplies a pressure stimulus for the alveolar bone, and, it is believed, the denture carries on the function of the natural tooth in this respect.

Free Circulation.—Entering into full denture construction is the increasing realization that the prosthodontist has devised many ingenious schemes for making dentures mouth-bound. Superior manipulative skill can make it difficult for the patient to remove his dentures. But, in the light of those biologic principles underlying this work, the result will be a definitely inferior one, for free capillary circulation is reduced, and the consequence of lack of nutriment to any part is well known.

Polished Dentures.—In a court of law, leaving a denture trimmed but unpolished may constitute a point for the plaintiff, as it is known that in some mouths an irritation of this kind may lead to malignancy. There is, too, that symptom of diabetes, a lowered resistance of the epithelial surfaces to injury, and dentures for diabetic persons should be free of all possible irritations. A polished surface is likewise a cleaner surface and, therefore, a healthier one.

Preservation of Muscle Tone.—Permitting a mouth to remain edentulous will cause facial muscles to contract and sag. Loss of muscle tone occurs when tooth opposition is removed and the muscular walls of the mouth collapse. No mouth should be permitted to remain edentulous, and, in view of this tendency, immediate insertion of the denture is advocated. Muscle tone will be restored with the replacement of artificial teeth.

DESTRUCTIVE PROCESSES OF THE MOUTH

Bone Resorption.—This may be the result of trauma from unbalanced occlusion or, indirectly, from the wearing of a tight fitting denture which causes capillary strangulation. Bone resorption, more remotely, may have a systemic cause with or without trauma or the effect of a tight fitting denture.

Tissue Proliferation.—Tissue proliferation may occur from the long-continued irritation from an ill-fitting denture, as is seen in the familiar pendulous soft tissue found in the mucobuccal fold, or the exaggerated form of a *labium frenum* for which insufficient accommodation was provided in the peripheral trimming of the impression.

Tissue Atrophy.—Tissue atrophy is associated with senility and certain debilitating diseases which leave the mouth in a shrunken state and the fit of the dentures much like the fit of a collar around the neck, or the clothes on the body of a sick and senile person.

Capillary Strangulation.—Beneath the dentures themselves are the small arteries

and capillaries which carry nutriment to the structures supporting the dentures. The pressure seal of dentures which are so mouth-bound that they must be forcibly removed causes strangulation of these vessels, which leads to resorption of bone, and ultimately to the loosening of the dentures. The familiar white, scalded appearance of the mouth is the first indication of what inevitably follows.

Muscular Deformities.—These occur through the lack of dental care or improperly constructed artificial dentures. The progressive loss of teeth and the failure to replace them causes a shortening of the bite, and therefore a decrease in the distance between the chin and the nose, all having the effect of broadening the mouth, thinning the lips, deepening the nasolabial lines and wrinkling the skin over progressively contracted facial muscles.

SUMMARY

Full dentures may (1) preserve or improve the facial characteristics of the patient; (2) promote digestion by the comminution of food; (3) function without rapid resorption of the bony supports; (4) promote normal health of the soft tissues; (5) preserve muscle tone and normal muscular contours; (6) provide a pressure stimulus to vital tissues; (7) allow free circulation of the blood to the underlying structures; (8) maintain the vertical dimension of the lower half of the face; (9) clarify speech and perfect its tonal quality, and (10) increase patient confidence and self-respect.

On the other hand, full dentures may (1) alter the facial expression through tooth selection and arrangement; (2) inhibit digestion by inadequate or inaccurate articulation; (3) induce resorption of bone by traumatic injury; (4) impair the health of the soft tissues by irritations; (5) cause flaccidity of muscles by insufficient fulness and height; (6) deprive the tissues of pressure stimulus by faulty adaptation; (7) retard circulation in the soft tissues by gripping retention; (8) create facial deformities by loss of the vertical dimension; (9) cause phonetic difficulties by faulty tooth arrangement, and (10) proclaim a failure and disappoint a patient.

Whereas the principles and procedures of full denture construction have been those commonly related to mechanics, even so far that the name given this branch of practice is mechanical dentistry, it is becoming increasingly evident, with the progress of medical and dental science, and with a wider view of their related studies, that the placing of an inert, non-vital, inflexible body upon vital, resilient tissues brings about a vital response of that tissue to that body. The general acceptance of full dentures by the soft tissues of the mouth involves a biologic response rarely favorable to the supporting tissues of the mouth. But the destructive processes of the mouth and face, particularly those of bone resorption and its accompanying progressive facial changes, could be largely prevented by a better understanding of the biologic aspects of this work.

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THE DENTIST'S RESPONSIBILITY IN ORAL CANCER

By David B. Ast,* D.D.S., Albany, N. Y.

THE purpose of this paper is to show how the dentist in his everyday practice can play an important rôle in reducing to a very appreciable extent the incidence of cancer and its resultant high mortality.

As you know, I am particularly concerned with the oral hygiene program for the New York State Department of Health and am directly affiliated with the Division of Maternity, Infancy and Child Hygiene. Bearing in mind that my work is almost exclusively with children of preschool age, we have, I believe, the right starting point for a discussion of ways and means of controlling the ever-increasing incidence of precancerous and cancerous lesions of the mouth. I can think of no better way to deal with any disease than to exercise every known precaution to prevent it. This is especially true of cancer.

James Ewing, in his treatise on prevention of cancer, tells us that we have considerable clinical information to prove that many forms of cancer are preventable, but there has been no systematic effort to impress this fact on the members of the healing art or to convey it to the public.

A striking example of what can be done with a definite program of education is to be seen in the pneumonia control program. Prior to the intensive and comprehensive program of enlightening the medical profession on the use of serums, the mortality rate was appalling. Today, the physician calls for a particular type of serum, and pneumonia is rapidly losing its place in the list of causes of high mortality.

The American Society for the Control of Cancer has definitely placed upon the dental profession the responsibility for preventing and detecting neoplasms in the intra-oral group. The dentist, fortunately, is in an advantageous position, because his field is so readily accessible for examination through ocular, digital and radiographic means.

The oral cavity is one of the important sites for the development of neoplasms. According to A. P. Stout, 4.5 per cent of all cancer diagnosed in a large group of cases were of the lip or oral cavity.

In 1929, more than 120,000 people in the United States died of cancer. The same census figures show that 4,000 people died in that year of intra-oral cancer, about 3.33 per cent. The mouth is placed fifth in the order of frequency.

Dr. Gooch, of the Division of Cancer Control, tells me that there are at the present time in New York State about 1,500 cases of malignant buccal cancer, of which approximately 500 will prove to be fatal.

I do not intend in this paper to consider the pathology and treatment of cancer of the buccal cavity, but rather

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to take up some of the contributing etiologic factors in precancerous and cancerous lesions.

It is generally accepted that cancer is a process characterized by an unrestrained growth of the cells of a particular part of the body. While there is no definitely known or, I should say, accepted cause for cancer, all authorities are in agreement that the growth of the neoplasm is preceded by a relatively long period of chronic irritation accompanied or followed by cellular hyperplasia.

Ewing tells us that the theory of tissue predisposition in its various forms becomes less and less satisfactory the more carefully we investigate the exact conditions of origin of the major types of cancer. A very important factor in the theory of heredity is that, with hereditarily predisposed subjects, the usual exciting conditions must be brought into play, and it is these conditions that come under the heading of preventable causes.

Among the preventable cancers, the most obvious are those that are found in the mouth. It is a recognized fact that cancers of the lips, tongue and tonsils are often associated with the presence of bad teeth, the use of tobacco or syphilis.

Badly decayed teeth with projecting, jagged edges against which the tongue and mucous membranes of the cheek and lip are constantly rubbing act as chronic irritants.

Pyorrhea, from the standpoint of being a chronic focus of infection and also owing to the irritating influence of mobile teeth, may be responsible for neoplasms, especially in the floor of the mouth.

Malocclusion due to such habits as thumb-sucking, lip-biting and resting the cheek on the hand involves an irregularity of the teeth wherein projecting cusps and food impaction areas may act as extrinsic sources of irritation.

Failure to replace missing teeth, permitting a shifting of the remaining teeth, likewise produces malocclusion and food impaction areas.

Faulty dental restorations, particularly of the partial and full denture type, come under the heading of sources of extrinsic irritation and are, in some mouths, factors in the etiology of cancer. With ill-fitting dentures which are continually bobbing up and down in the mouth, we have irritation from the denture in rubbing against the mucous membrane of the palate, lip, cheek and the gingiva of the supporting teeth. Also, we must contend with excessive pressure in certain areas.

At this point, it is advisable to call attention to the fact that frequently the patient fails to return to have the necessary adjustments made on dentures and, in a short time, accustoms himself to the denture as it is and suffers the results of traumatization of the tongue, cheek and lips. Patients should return for a periodic checkup of dentures. Many people are of the opinion that once they have a denture, their dental problem ends. That is a fallacy. From pressure against the alveolar ridge, resorption frequently occurs, necessitating relining or remaking of the denture.

Fillings, inlays and crowns which have excessive and sharp margins pressing against the gingiva and interproximal papilla are definite sources of irritation.

The continued use of escharotics for the treatment of soft tissue lesions, particularly silver nitrate, should be avoided. H. Solomon reports that many cases of intra-oral epithelioma are seen at the New York Institute for the Study of Malignant Diseases in which a small benign lesion has been "touched up" with silver nitrate over a few months, with the result that a definitely malignant lesion is produced.

Irritation resulting from the excessive use and abuse of tobacco is considered to be largely responsible for cancer of the lip. Many observers report that it is the main cause of leukoplakia. A. P. Stout reports that in ten years he saw

thirty squamous-cell epitheliomas of the lower lip and none of the upper. Twenty-nine of the patients were men and one was a woman.

Fox studied forty cases of leukoplakia buccalis, thirty-eight in men and two in women. All of the men were smokers. Twenty-six of them had syphilis. His study brought out very clearly that the more common causes of epithelial hyperplasia in the mouth were syphilitic lesions, heavy smoking and the presence of bad teeth.

Other forms of cancer in the oral cavity are associated with occupational habits, such as the cobbler's holding nails in his mouth and slipping them out one at a time, and the seamstress' holding pins in her mouth, or biting thread.

To tie up this subject with oral hygiene and preventive dentistry is, in my opinion, one of the more important problems facing the dental profession today.

With our records showing that from 90 to 95 per cent of all children entering school have dental defects, it is incumbent on the dentists as practitioners of the healing art to take the necessary steps to correct this state of affairs. In order to meet the problem, we must have definite objectives, a firm foundation and a willingness to cooperate with the various agencies concerned with the health of the public.

In our oral hygiene program for the state, a definite and comprehensive plan has been proposed which I hope will foster a better understanding and closer relationship between the public and the dental profession. By bringing to the attention of the public the whys and wherefores of oral prophylaxis, and the urgency of early correction of dental defects, we expect to reach that large section of the public which has never had any dental attention and to make them understand the importance of our work for them and especially for their children.

In the order of importance, let us first discuss the objectives which we have set for ourselves. Our ultimate goal is to establish better oral health, which in turn influences to a marked degree the general health of the public.

Our primary concern in this phase of the work is to educate both the profession and the laity. The public must be educated to realize the necessity for oral prophylaxis and early correction of dental defects and the benefits to be derived therefrom, and also the influence of diet, both prenatally and during those most important early formative years of life.

The dental profession is being educated to realize the urgency and desirability of children's dentistry. Unfortunately, many dentists themselves regard it as unimportant to treat the deciduous teeth. Through either ignorance, or lack of ability in handling children, or because they regard children's dentistry as unremunerative, they do not urge parents to have the deciduous teeth filled. This is a grave error. Children's dentistry can be very interesting and a great help as a practice builder. Refresher courses in children's dentistry are planned in various localities in which we set up our program for the purpose of bringing the story of preventive dentistry right to the dentist's doorsteps.

The educational program for the public will be outlined to parents of children of preschool age at the chair while the hygienist is cleaning the child's teeth. The proper technic of using the toothbrush and the necessity for daily oral hygiene will be stressed. This will be supplemented by lectures to groups such as parent-teacher associations, with charts, models, moving pictures, newspaper articles, etc.

The next step is to build a firm foundation. The patients with whom a preventive dentistry program should start are the prenatal patient and the child of preschool age. In fact, my particular problem in the state department of health

program concerns itself primarily with these two classes of patients. The effect on the oral health of the pregnant woman and on her diet during pregnancy and lactation is of great importance, first to the developing fetus and later to the growing infant.

As far as the state department's work in this field is concerned, I shall outline briefly just how we expect to function in a particular community. At the same time that the preschool consultations and prenatal consultations are being held, the dental hygienist will be present to examine and give a prophylactic treatment to each patient. She will record the teeth in which she finds dental defects. She will take the time to talk with the parent regarding oral hygiene, mentioning some pertinent facts concerning the development of the teeth and the urgency of proper care at home.

Through the local county dental society, we obtain a list of those members of the profession who are willing to cooperate with us in caring for these patients. Those patients who can afford to pay for their dental care will be expected to go to their family dentists. The welfare patients and the borderline cases, whose status will be passed upon by the local county society committee, with recommendations from the public health nurse, will be cared for preferably in the offices of the cooperating dentists. These dentists will be paid at the rate of $12.50 for a full three-hour session. This time must be set aside for our work exclusively. This rate is fixed for the operations to be carried out in the dentist's office, with his own equipment and material. If the operations are to be performed in a health clinic, the rate will be $10 for a three-hour session.

The work to be done is of the simplest type consistent with good technic and satisfactory results: simple amalgam fillings and compound amalgam fillings with cement bases, with proper carving, contouring and polishing of all fillings; the use of silver nitrate reduced with eugenol or other agent in pits and fissures, with no root-canal therapy in deciduous teeth.

I am not so optimistic as to feel that even with an unusually successful program we can do away with all dental defects, but I do know that we can prevent gross rampant caries with resultant loss of teeth, shifting and malposition of the remaining teeth and the necessity for restorative procedures, which, on occasion, owing to their irritating influence, may produce precancerous lesions.

James Ewing concludes an article on prevention of cancer by saying:

> It appears more and more evident that early diagnosis alone is not capable of accomplishing the desired reduction in the death rate. Every experienced observer knows that the patient coming in with an early diagnosis all too often fails completely of a cure. The list of cases incurable from their first recognizable beginning is a long one. The experience of patients accomplishing a cure of early cancer is generally a severe one, while the fate of the failures is passed over in silence. The public know these facts and therefore any plan of successfully meeting the problem of cancer control must lean heavily upon cancer prevention.

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DECEMBER *Editorial Department* 1939

A CENTENARY OF DENTISTRY

ON March 18, 19, 20, 1940, the American Dental Association, in collaboration with the dental profession of the city of Baltimore and the state of Maryland, will celebrate the National Dental Centenary of the foundation of the dental profession as a distinct specialty of the healing art.

It was in Baltimore in 1840 that Horace H. Hayden and Chapin A. Harris conceived the idea of an institution devoted to instruction in the art and science of dentistry; and it was these two guiding spirits who wisely, patiently and painstakingly materialized a project eventuating in a separate and distinct specialty of the healing art, a specialty that has played an important rôle in the recognition of the relation of mouth diseases to diseases of the general system.

In the early years of dentistry as a special department of the healing art, these two leaders gave unstintingly of their energy and intelligence in shaping the future of a rapidly developing profession. The three foundation stones upon which dentistry still stands—the School, the Journal and the Society—were laid by them, and it was their indomitable cour-

age and foresight that assured the continuing stability of the young profession. The society—the American Society of Dental Surgeons—was directly succeeded by our present American Dental Association; the journal—the *American Journal of Dental Science*—was eminently successful as long as Harris directed its destinies, and the school—the Baltimore College of Dental Surgery—is still enjoying a highly successful career. It is to these tripodic interests that dentistry owes its existence and conspicuously successful development under, at times, exceedingly adverse circumstances.

Measured by the record of medical antiquity, one hundred years is but a short span of professional life, but, measured on the basis of accomplishments, these hundred years have witnessed a marvelous growth in a specialized profession that has abundantly demonstrated its value in the general scheme of preservation of bodily health.

Until the eighteenth century, there was little of the practice of dentistry that deserved the name, even though, in France, Fauchard had made an effort to distinguish dental practice from medical practice.

From the beginning of the eighteenth century, almost to the year in which dentistry as an organized profession was established, the practice of dentistry was marked by a constant struggle between the charlatan and a small band of idealists who were bent upon the establishment of dental practice as a recognized branch of the healing art, but whose number and lack of organization considerably delayed the fruition of the new profession. The type of men thus imbued and their determination to establish the practice of dentistry on a comparable basis with surgery and the medical specialties finally resulted in the event whose centenary we plan to celebrate in Baltimore in 1940.

The launching of a well-conceived professional procedure did not, however, solve all the problems and prepare an easy way for the future. Despite the professional idealism of Hayden, who envisioned the practice of dentistry as an important ancillary branch of medicine, with significant systemic and general connotations, there were those high in the councils who continued to bow down to the idols of gold.

The experience of Hayden as a long-time practitioner of medicine had impressed upon him the close relationship of dental disease to bodily health, and it was these observations which led him to seek special instruction in dentistry in the medical school. His ambitions were denied from that source, and he sought the alternative of heading a movement for the establishment of a separate profession, which resulted

in the founding of the Baltimore College of Dental Surgery, in Baltimore, in 1840. Then followed one hundred years of unceasing effort on the part of the dental profession to attain the ideals of Hayden and Harris; an effort that met with varying degrees of success and was attended by frequent vacillations from the medical to the mechanical concept of dental practice. And it has been within only the past few decades that dentistry has returned to the ideals which were fostered by its founders. Today, however, the course and the purpose of dentistry seem to be clearly charted and determined, and it is for this reason, if for none other, that we should enter into the spirit of the celebration of our one-hundredth anniversary with doubled and trebled enthusiasm and appreciation of the efforts and ideals of our pioneering forefathers.

The prosecution of the professional project begun by Hayden and Harris in the establishment of the school necessitated development of several associated phases; mainly, a society for the social and professional contacts of those practicing the new specialty, and a journal for the establishment of broader contacts and, too, to disseminate education to all dentists through its office as an educational institution.

As would naturally be expected, both Hayden and Harris were quite interested and active in the formation of the society—the American Society of Dental Surgeons—Hayden becoming the first president and Harris the first secretary. Both Hayden and Harris were intimately associated with the promotion of the journal—the *American Journal of Dental Science*—Harris as one of the editors and Hayden as a regular contributor to the columns of the journal.

Thus were laid the three foundation stones—the School, the Journal and the Society—upon which Hayden and Harris and their confrères began to build the profession of whose accomplishments we are so proud that we are proposing a celebration of its one hundredth anniversary; a celebration which should and, we believe, will be one of the outstanding events in the history of the profession. Every member of the profession is morally and professionally obligated to show his appreciation of his profession and of the efforts of the founders of dentistry by an active interest and participation in some phase of the celebration.

The Baltimore local profession is now busy perfecting the arrangements for the Centenary, and, in a later issue, we shall publish a preliminary program for the information of those who contemplate attending the celebration, as well as for those who are compelled to

forego that privilege. Every phase of dental practice will be represented during the three-day meeting, by speakers and essayists of national and international reputation; ample accommodations will be available for all, and entertainment, both literary and social, will be provided for an anticipated large and representative dental audience.

Because the celebration is being held in collaboration with the American Dental Association, it should receive the cooperative support of all loyal dentists, to the end that we may make the Dental Centenary one of the most significant events in the history of dentistry.

NINETY-FIFTH ANNIVERSARY OF THE DISCOVERY OF ANESTHESIA BY WELLS

DECEMBER 11, 1939, marks the ninety-fifth anniversary of the discovery of anesthesia by Horace Wells.

It was on this corresponding date in 1844 that anesthesia, by means of nitrous oxide gas, was conceived, demonstrated and proclaimed by Horace Wells, a dentist of Hartford, Conn. The ninety-fifth anniversary of this event will be celebrated in Hartford December 11, at a banquet given by the Horace Wells Dental Society of Connecticut.

The story of the discovery of anesthesia is one that is familiar to dentistry, signalizing one of dentistry's notable contributions to the alleviation of pain from surgical procedures necessitated by disease or otherwise.

As was the case in many of the important discoveries of man, much controversy has arisen as to the time and by whom the discovery was actually made. It has been fairly well established that two years previous to the day on which Horace Wells demonstrated anesthesia by means of nitrous oxide, Crawford W. Long, of Athens, Ga., had used ether; that two years after Wells' experiment, William T. G. Morton, of Boston, Mass., discovered and demonstrated the anesthetic properties of sulfuric ether. The evidence seems to be convincing, however, that Wells was the first to recognize the principle of anesthesia and to successfully demonstrate it and proclaim the discovery to the world.

Although Long produced anesthesia a year or two previously to Wells, he did not make his discovery known until after Wells had made public demonstration and announcement of the discovery of the prin-

ciple, and dentistry, we believe, is fully warranted in claiming for one of its devotees the honor of the discovery.

It is quite appropriate that this memorial banquet be held in Hartford and under the sponsorship of the members of the Horace Wells Society, as Hartford and Hartford dentists were most active in making this panacea of pain available to the world. Dr. Wells was assisted in his experiments in producing anesthesia by John M. Riggs, a dentist, who, it is recorded, extracted a tooth painlessly for Wells under the anesthesia produced by what was then known as "laughing gas." The gas was administered by Prof. G. Q. Colton, who was accustomed to demonstrating the sleep-producing effect of the gas for amusement purposes and who prompted its use in extracting teeth for many years after the Wells discovery.

Within the year, there have been some misguided efforts to disparage the important rôle which Wells played in the discovery of this boon to mankind, but this, we believe, may be attributed to an undue zeal on the part of literary commercialists in endeavoring to publicize one of the romantic incidents of dental history.

In this year just preceding 1940, the one-hundredth anniversary of the founding of dentistry as an autonomous profession, we trust that the honor and glory of the discovery of the greatest gift toward the alleviation of human pain—anesthesia—will be graciously conceded to the one who rightfully deserves it—Horace Wells, a dentist, of Hartford, Connecticut.

CHRISTMAS SEALS

THE President, Dr. Merritt, sends to you in this issue a special appeal for your help in materially increasing the Relief Fund during his administration through the purchase of Christmas Seals.

Read the President's Message on pages 2058-2059 and send in your dollar (or more) to the American Dental Association Relief Fund, 212 East Superior Street, Chicago, Ill. Every dollar helps and we know of no more worthy cause than the Relief Fund.

BUY CHRISTMAS SEALS!

OBITUARY

THOMAS L. GRISAMORE
(1875-1939)

THOMAS L. GRISAMORE was born near Centralia, Ill., October 17, 1875, and died at his home in Wilmette, Ill., October 16, 1939. He is survived by his wife, Eva Smith Grisamore, a daughter, Mrs. William R. Bayliss, and a son, Thomas L. Grisamore, Jr., who was associated with his father in the practice of orthodontia.

Dr. Grisamore received his early education at the Centralia High School, McKendree College and the Illinois State Normal School. After a brief public school teaching experience, he entered the Northern Indiana Normal School, graduating in pharmacy in 1896. He received his dental degree from the Chicago College of Dental Surgery in 1898, and engaged in the general practice of dentistry in Chicago until 1911, when he limited his practice to orthodontia.

From almost the beginning of his professional career, Dr. Grisamore was associated in a teaching relation to dentistry. In 1903, he became an instructor in materia medica and therapeutics in the School of Dentistry, University of Illinois; in 1904, he became associate professor of the same subjects, and, in 1905, he was made professor of dental chemistry and metallurgy. In 1908, he accepted the position of instructor in orthodontia at the Chicago College of Dental Surgery; in 1910, he was made associate professor, and, in 1919, he was advanced to the rank of professor, succeeding to the professorship formerly held by the late Calvin S. Case.

Dr. Grisamore was honored with many positions of importance and responsibility in organized dentistry, in each instance justifying the trust and confidence reposed in him. He was secretary of the Chicago Dental Society from 1909 to 1913; president-elect in 1913-1914, and president in 1914-1915. He was a member of the Executive Council of the Illinois State Dental Society from 1915 to 1918; treasurer from 1918 to 1926, the longest period that any member has served this society as treasurer; president-elect, 1926-1927, and president, 1927-1928. He was Vice President of the American Dental Association in 1919, and served as Trustee of that organization from the Illinois District from 1932 to 1938.

Dr. Grisamore was Grand Master of the Chicago Auxiliary of Delta Sigma Delta Fraternity in 1926, and a member of Omicron Kappa Upsilon, honorary dental fraternity. He was a member of the Chicago Dental Society, the Chicago Odontographic Society, the Illinois State Dental Society, the American Dental Association, the Chicago Association of Orthodontists and the American Society of Orthodontists, and a Fellow of the American College of Dentists.

A quiet, unostentatious, painstaking and cultured gentleman, Dr. Grisamore was faithful to every obligation, stable in character, affable in manner, pleasing in demeanor and consistent in devotion to what he believed to be right. His unvarying good nature and comradeship won for him the deep affection and admiration of a host of friends. He had a keen concept of his duty to his students, and his interest in them continued through their professional careers. His home life was most exemplary and typical of the best traditions of that essential unit of our American civilization.

Participation in useless controversial

questions was avoided by Dr. Grisamore, who conserved his energy and his interest for those things which he thought were really worth while to his family, his friends and his profession. He was always loyal to his friends, a man of deep feeling; yet it is doubtful whether his voice was ever raised in anger; and herein may be found one of the major reasons why the children who formed the greater part of his clientele not only held him in high regard, but also had a great affection for him. All of these facts contributed to the gradual unfoldment and development of the man and the practitioner, who for forty-one years proceeded steadfastly from one endeavor to another as he was entrusted with increased responsibility as a teacher, as a dental officer and as a dentist.

Thomas L. Grisamore, D.D.S.
(1875-1939)

Dr. Grisamore left a heritage of which any man should be proud and which will redound to the benefit of the dental profession and through it to humanity.

COUNCIL ON DENTAL THERAPEUTICS

SIGNIFICANCE OF TESTS FOR THE EVALUATION OF ANTISEPTICS AND GERMICIDES*

By HOLMES T. KNIGHTON, D.D.S., Louisville, Ky.

LONG before the acceptance of the germ theory of disease, attempts were made to compare the effectiveness of different substances in preventing or delaying putrefaction. Since the development of bacteriology as a science, work of this nature has attracted numerous investigators.[1] The need for a standardized technic has been recognized for some time. In 1903, Rideal and Walker[2] employed a phenol coefficient test in an effort to evaluate the disinfectant action of chemical substances. Their technic was improved in 1921. Many other attempts have been made to improve this test, the most notable examples of which are the Hygienic Laboratory (H. L.) Method[3] and the Food and Drug Administration Phenol Coefficient Method (F.D.A. Method).[4]

The principle employed in the various modifications is similar to that of the Rideal and Walker test. This principle is illustrated in the following description:

The phenol coefficient is a figure expressing the ratio of the killing efficiency of a disinfectant as compared with that of phenol tested under identical conditions. The sample to be tested is diluted and the dilutions arranged in a series of decreasing concentrations (increasing dilutions). To these a specified amount of the test organism in broth culture is added. At the end of fixed periods of time a small definite portion of the mixture of diluted disinfectant and test organisms is transferred to a nutrient culture medium and incubated. No growth in the subculture indicates that the organism has been killed. The greatest dilution (weakest concentration) of the disinfectant killing in a definite time period is divided by the greatest dilution of phenol killing in the same time period. This ratio is the phenol coefficient.[4]

A brief general summation of the F.D.A. technic[4] follows:

1. The culture media must be carefully and exactly prepared, adjusted to a definite pH and sterilized.

2. Five cubic centimeter amounts of accurate dilutions of the disinfectant to be tested and similar amounts of the desired dilutions of standardized phenol (U.S.P.) are placed in standard test tubes. These aqueous solutions, which should be about room temperature, are placed in a 20° C. water bath (unless otherwise specified) and left for five minutes, or until the temperature of the water bath is reached.

3. Exactly 0.5 cc. amounts of a 22 to 26 hour broth culture of *Eberthella typhosa* (Hopkin's strain) are placed in each dilution of the disinfectants. The strain of *Eberthella typhosa* is always used unless otherwise specified and must be such that it is killed by a 1:90 dilution of phenol in ten minutes, but not in

*The article by Dr. Knighton is presented as one in the Council's series on pharmacology and therapeutics. On behalf of the profession, the Council expresses appreciation to the author for his contribution. Harold L. Hansen, *Secretary*.

From the Department of Public Health and Bacteriology, School of Medicine, University of Louisville.

five minutes, and must be resistant to a 1:100 dilution of phenol for fifteen minutes.

4. At exact intervals of five, ten and fifteen minutes from the time of seeding each dilution, a loopful of the mixture of disinfectant and organisms is transferred to a corresponding 10 cc. amount of sterile broth. The loop must have an inside diameter of exactly 4 mm. and should be bent to form an angle of 60 degrees with the stem (23 B. and S. gage platinum wire.)

5. The subculture tubes are incubated at 37° C. for forty-eight hours. Results are usually read by microscopic examination, turbidity indicating growth. Subcultures on agar or microscopic examination may be used in doubtful cases.

6. The result of the test is expressed in terms of the phenol coefficient, a figure obtained by dividing the numerical value of the greatest dilution (the denominator of the fraction expressing the dilution) of the disinfectant killing the test organism in ten minutes, but not in five minutes, by the greatest dilution of phenol giving the same results. Thus, if the results were as follows:

Disinfectant (X)	5 minutes	10 minutes	15 minutes
1-300	0	0	0
1-325	+	0	0
1-350	+	0	0
1-375	+	+	0
1-400	+	+	+
Phenol			
1-90	+	0	0
1-100	+	+	+

+ representing growth in subcultures and 0 representing no growth in subcultures, the phenol coefficient of X would be 350/90, or 3.9. In order to avoid an impression of fictitious accuracy, the phenol coefficient, if greater than one, is reported to the nearest 0.1.

The accompanying table[4] is inserted to stress the importance of standardization, the general similarity between the three most recognized tests and the points of difference between the tests. The points of advantage possessed by the F.D.A. method are discussed in Circular No. 198[4] and by Reddish.[5]

Variation in any of the numerous factors may influence the results. Some of these factors are nutritional properties and pH of the medium,[4, 6, 7] standard resistance of the test organism,[4, 6, 7] calibration of pipets,[4] standard requirements of phenol,[4] temperature,[4, 6, 1] time between transplants[7] and size of subculture tubes.[8] Needless to say, it is evident that the tests should be made by scientifically minded and broadly trained persons, or under their supervision.[8]

The phenol coefficient test was developed for comparison of the efficiency of phenol and phenol-like compounds as disinfectants for use on inanimate objects.[4, 9] A disinfectant, as it is used here, is defined in the Insecticide-Disinfectant Code as follows: "The term disinfectant as used herein means any chemical or drug or combination of chemicals or drugs intended to destroy one or more kinds of disease germs, or other harmful micro-organisms (not including bacterial spores) when applied to all inanimate objects that might harbor disease germs."[10]

This test is not intended for comparison of chemicals unrelated to phenol, such as mercurial compounds, oxidizing agents and halogens, or substances not soluble in water. The test does not take into consideration the destruction of bacterial spores. It is evident that the presence of organic matter will lower the efficiency of practically all of the chemical compounds. The phenol coefficient tests are performed with *Eberthella typhosa* unless otherwise stated.[4]

In view of the preceding limitations and in order to employ a safe margin for the disinfection of inanimate objects, phenol or phenol-like compounds are usually employed in dilutions comparable to a 5 per cent phenol.[4, 11] This is ob-

tained by diluting the disinfectant to twenty times its phenol coefficient. For example, phenol has a phenol coefficient of one; therefore, 20×1 or a 1:20 dilution would be used. If a disinfectant had a phenol coefficient of five, 20×5, or a 1:100 dilution, would be employed.

DIFFERENCES IN MEDIA AND MANIPULATION OF THE THREE METHODS OF DETERMINING PHENOL COEFFICIENT

Item	F.D.A. Method	R-W Method	H.L. Method
Composition of medium	Peptone,* 10 gm. Liebig's beef extract, 5 gm. Salt, 5 gm. Water, 1,000 cc. Boil 20 minutes	Peptone,† 20 gm. Liebig's beef extract, 10 gm. Salt, 10 gm. Water, 1,000 cc. Boil 30 minutes	Peptone,* 10 gm. Liebig's beef extract, 3 gm. Salt, 5 gm. Water, 1,000 cc. Boil 15 minutes
Acidity of medium	pH 6.8	+1.5. No definite pH	Unadjusted, but pH between 6.0 and 7.0
Amount of culture medium in tube	10 cc.	5 cc.	10 cc.
Amount of culture added to diluted disinfectant	0.5 cc. to 5.0 cc.	0.5 cc. to 5.0 cc.	0.1 cc. to 5.0 cc.
Resistance of test culture to phenol (dilutions killing in 10 minutes but not in 5 minutes)	1-90	1-90 to 1-110	No limits stated
Conditions of tube in test	Plugged with cotton	Plugged with cotton	Open tubes
Temperature of test	20° C.	15-18° C.	20° C.
Time interval of test	5, 10 and 15 minutes	2½, 5, 7½, 10 minutes	5, 7½, 10, 12½ and 15 minutes
Amount of medication mixture transferred (size of loop)	4 mm. loop (of No. 23 B. and S. gage wire)	4 mm. loop (of No. 27 Imperial gage wire)	Spiral loop (four spirals wrapped around a No. 13 B. and S. gage wire. Made of No. 23 B. and S. gage wire)
Calculation of phenol coefficient	Highest dilution not killing in 5 minutes, but killing in 10 minutes, divided by same for phenol	Highest dilution not killing in 5 minutes, but killing in 7½ minutes, divided by same for phenol	Mathematical mean of highest dilutions showing no growth in 5, 10 and 15 minutes, divided by same for phenol

*Armour's. Special batch set aside for disinfectant testing.
†Allen & Hanbury's.

OTHER TESTS FOR GERMICIDES AND ANTISEPTICS

The limitations of the phenol coefficient test are responsible for many variations in technic intended to more closely simulate practical conditions. The fact that many chemicals are selective in their action on different types of bacteria is an indication for the use of more than one test organism.[4, 5] "The F.D.A. method (special) *Staphylococcus aureus*"[4] is a technic using the general principle of the phenol coefficient, modified to meet this need in a certain measure. If the disin-

fectant is recommended for external use, the temperature should be 20° C., but if it is for use as an antiseptic in the body cavities or in wounds, 37° C. is the constant temperature to be used in the test. The resistance of *Staphylococcus aureus* should be such that a 1:80 dilution of phenol will kill it in ten minutes, but not in five, at 37° C.; or a 1:60 dilution of phenol will kill it in ten minutes, but not five, at 20° C.

Soluble antiseptics or those completely miscible with water may be tested by this method. "In the testing of these substances, however, the phenol coefficient is not obtained necessarily, the phenol figure being used merely as a check of the resistance of the test organism. The information desired is the concentration which will kill in five minutes."[4]

Other organisms may be used, with necessary variations in media, but the lack of standardization of the resistance of the organisms, as well as the difficulty of growing such organisms as *Mycobacterium tuberculosis*, detracts from the value of such tests.

One of the earliest of the practical variations was the addition of sterilized fecal material to the test dilutions.[12] Since the disinfectants are so often required to kill organisms in the presence of fecal and other organic material, the value of such a variation is evident. The difficulty of securing suspensions of absolutely uniform particles is one of the chief objections to this modification.[13]

Addition of serum to the diluent is a special modification, but there is apparently no standard amount of serum recommended for use.[4, 14]

The wet filter paper method[4] is recommended for substances not soluble or completely miscible with water or for substances used in high concentrations as soaps, tooth pastes, dyes, salves and ointments. This test consists of soaking 0.5 cm. square pieces of sterile No. 2 Whatman filter paper in a 24-hour broth culture of a standard resistant strain of *Staphylococcus aureus*. The pieces of filter paper are then placed in the substance in question in such a way that they are completely covered and in intimate contact. At the end of five, ten or fifteen minutes or one hour, the squares are transferred to 10 cc. of sterile broth and washed as free of the test substance as possible before being transferred to a second tube of sterile broth (10 cc.). Both subculture tubes are incubated at 37° C. for forty-eight hours and then examined for growth.

The dry filter paper method,[4] a modification of the preceding test, may be used for evaluating gaseous substances.

These tests have many of the limitations of the phenol coefficient test, in addition to the fact that it is more difficult to make subcultures.

The agar plate method[4] may be used to test the inhibitory (bacteriostatic) properties of salves, dusting powders, creams, etc. *Staphylococcus aureus* is usually employed as the test organism. From 15 to 20 cc. of agar is melted and allowed to cool to 42 to 45° C., at which time 0.1 cc. of a 24-hour broth culture is added. The agar is then poured into a sterile Petri dish and the test substance is placed in contact with the agar immediately after the latter hardens. The plates are incubated at 37° C. for from twenty-four to forty-eight hours, and if the preparation has demonstrable bacteriostatic properties, a zone of clear agar will be noted. The addition of 10 percent sterile horse serum is sometimes used in the agar in an effort to simulate practical conditions.[4]

The agar cup plate test[4] may be used for substances liquid at the temperature of the test. It differs from the preceding tests only in the fact that the substance to be tested is placed in wells (1.5 cm. in diameter) cut in the agar.

These agar plate tests are designed chiefly for testing the bacteriostatic effect of substances expected to exert their effect over a prolonged period of time.

Consistent results are possible with the cup plate method, if careful attention is given to[15]: (1) the antiseptic, (2) species and strain of micro-organism, (3) size of the inoculum, (4) pH of the medium, (5) agar concentration, (6) thickness of the agar in the plate and (7) length of time between the preparation of the plate and the addition of the antiseptic. However, there is a need for a standard of comparison. Bryan,[16] for instance, has suggested a mercury ointment coefficient.

Reference to numerous other tests and modifications of the previously described tests may be found in the literature. A test may seem promising, but before too much dependence is placed on it, it must give consistent results in the hands of different investigators.[7] Lewis and Rettger's[17] study and criticism of Allen's suggested method is illustrative of this fact.

TISSUE TOXICITY AND IN VIVO TESTS

The phenol coefficient and other tests described above give no indication of the tissue toxicity of various chemicals. There is undoubtedly a need for such tests as well as more exacting tests relative to the efficiency of antiseptics *in vivo*.

Hunt[18] has reported interesting results from injection of an invasive strain of *Staphylococcus aureus* intracutaneously into mice. The antiseptics were adjusted to a strength twenty times the dilution killing the test organism in five minutes *in vitro*. These dilutions of antiseptics were either injected with the organisms or at definite intervals after the injection of the organisms. Hunt's results are interesting in that he found mercurial compounds failed to prevent infection if mixed with the organisms just before injection. None of the drugs which he tried were capable of preventing or shortening the time of necrosis after the infection was once started.

Following is a brief summation of other interesting tests involving tissue toxicity as well as germicidal properties.

Lambert and Meyer's[19] method involved the use of rabbit's spleen for an evaluation of tissue toxicity, with *Staphylococcus aureus* as the test organism.

Salle and his associates[20] obtained a toxicity index by dividing the highest dilution of an antiseptic detrimental to the growth of chick embryo tissue by the highest dilution capable of killing micro-organisms in a definite time.

Nye's[21] experiments include bacteriostatic and bactericidal tests in broth and in 50 per cent serum; bacteriostatic and bactericidal tests of the dialysate of the chemicals obtained by his described method; the inhibition of phagocytosis by the chemicals, and tests of the toxicity of injected chemicals.

One of the most interesting findings in a study of the three preceding tests is the fact that all agree on iodine as the most nearly ideal antiseptic from a combined low tissue toxicity and bactericidal standpoint. However, in a recent report of results obtained by a manometric method, iodine was inferior to some of the newer disinfectants.[22]

Clinical observations for the evaluation of antiseptics are valuable, but they lack the uniformity of well-planned laboratory tests.[7] Results of both clinical and laboratory tests can be misleading unless one understands the technic employed, the limitations of the tests and the pharmacology of the drugs used.

INTERPRETATION OF TESTS

Many of the shortcomings of laboratory tests lie in the possible misinterpretation of the results and in the misleading advertising. A partial list of points to consider in evaluating test results and in choosing antiseptics and germicides follows.

1. Comparison of the usable dilution with the antiseptic or germicidal strength. For example, a usable dilution of a compound solution of iodine in certain locations is a 1:20 dilution and for mercuric chloride is a 1:1,000 dilution. If the highest germicidal dilution of the iodine

compound is 1:4,000 and of mercuric chloride is 1:20,000, it is assumed that mercuric chloride is five times as germicidal as the iodine compound; but if the germicidal dilution of each compound is divided by the usable dilutions, the iodine (4,000/20 or 200) would be ten times as valuable as the mercuric chloride (20,000/1,000 or 20).[21]

2. The terminology is often confusing.[23]

According to current usage, the word "antiseptic" has two meanings: to kill bacteria or to prevent their growth, depending upon the use of the product. Products such as salves, ointments, and dressings that remain in contact with the body for long periods of time may be designated properly as antiseptics if they inhibit the growth of bacteria. On the other hand, mouth washes, douches, gargles, and preparations of like nature are in contact with the body for but brief periods of time and exert negligible inhibitory action. These may be described properly as antiseptics only, if they will destroy bacteria under the conditions of use; that is, in the dilutions recommended and in a period of time comparable to that in which they would have an opportunity to act when used as directed.[4]

3. A substance may kill certain vegetative test organisms such as *Staphylococcus aureus,* in a certain time under certain conditions and is, therefore, germicidal (or bactericidal) for this organism under these conditions; but this would not be definite proof that the substance is germicidal for other organisms, and certainly not for spores.

4. A chemical may be germicidal for spore-bearing organisms as *Cl. tetani* and *B. anthracis* in their vegetative stages, but it would be misleading to advertise the chemical as germicidal for these genera of organisms unless the tests were made on suspensions of spores of the organisms.[24]

5. "Sterilize" and "sterilization" [23] are absolute terms, and it is incorrect to assume that a chemical will sterilize a substance unless that chemical is capable of killing all organisms, including spores, within the stated time to be used for sterilization.

6. A volatile substance may be an excellent germicide when tested, but owing to possible deterioration, it is not safe to assume that the substance has the same value when used later.[16, 25]

7. A substance may have a high germicidal value when tested in its pure state, but, in combining with other substances, this efficiency may be decreased. For example, phenol and its derivatives begin to lose germicidal efficiency at a pH of about 10 and the loss becomes marked at a pH of 11-12.[26] Likewise, chlorine may exert a quicker killing time at a pH of 6 than at an initial alkaline pH of 8.7 or more.[27] The addition of some substances in order to lower the surface tension and thereby increase the effectiveness of a drug may sometimes actually protect the bacteria.[1] These and other points are reasons for evaluating antiseptics and disinfectants in the combinations for which their use is intended.

8. Many substances, including mercurial compounds, are highly bacteriostatic (inhibitory) and give exaggerated germicidal (bactericidal) value when tested by the usual phenol coefficient method, necessitating the neutralization of the inhibitory factor on the organism otherwise assumed to be dead.[1, 18, 23] This neutralization can be accomplished by subculturing from the first subculture, by washing out the substance or by the use of a neutralizing agent such as hydrogen sulfide for the mercurials.

9. Chemicals behave differently when diluted.[1] For example, the germicidal efficiency of one solution may be decreased 16 times by a 1:2 dilution, while another may be decreased only 2 times with the same dilution. Thus, the evaluation of a substance should be made in the dilution recommended for use.

10. Correct comparisons of the germicidal efficiency of different chemicals are not necessarily obtained if the results

from different types of tests are used.

11. Tests for the antiseptic and germicidal properties do not always give authentic evidence relative to the value of chemotherapeutic agents.[28]

VALUE OF THESE TESTS IN DENTISTRY

In the Oral Cavity.—It is generally conceded that no germicide will kill all micro-organisms on the mucous membranes without injuring the tissues.[30] Several clinical tests for evaluation of skin and mucous membrane disinfection have been reported and should be considered with the laboratory tests.[31, 32] These laboratory tests should be for germicidal efficiency. Toxicity indices also should be considered.

It is not the intent of this report to evaluate different chemicals. However, two interesting points have been evident in a review of recent papers: (1) the efficiency of iodine as compared with other chemicals[19, 20, 21] and (2) the comparatively high efficiency of solvents such as alcohol and acetone[21] in skin disinfection.

If we assume that an efficient antiseptic should be incorporated in tooth pastes and mouth washes, tests for toxicity indices, according to Salle's and Nye's experiments, would seem to offer the most hope for a correct evaluation of these substances. No method or combination of methods has been devised which will give a thoroughly satisfactory comparison of germicidal agents in the test tube with conditions as they actually exist in the mouth.[24] The following conditions are probably responsible for conflicting reports on the antiseptic value of tooth pastes and mouth washes: (1) the dilution of antiseptics by the saliva; (2) the presence of organic material; (3) the presence of numerous organisms in the crevices of the mouth and in the oral tissues; (4) inability to obtain uniform suspensions of organisms in mouth rinsings; (5) inability to cultivate many of the organisms,[29] and (6) lack of any definite standard of evaluating *in vivo* action of chemicals in the mouth. But do we actually need tooth pastes and mouth washes for other than mechanical cleansing purposes?[25]

The phenol coefficient tests employing both *Eberthella typhosa* and *Staphylococcus aureus* should be applicable for evaluating chemicals for the disinfection of root canals and cavities before restorations, since phenol and phenol-like compounds are so often used. Cup plate tests with serum in the medium should also yield interesting data. Horton and Kitchin[33, 34] have reported experiments along these lines. They report that S.T. 37 failed to give negative cultures when used in root canals even over long periods of time.[33] In a second paper, these investigators report that the antiseptic power of hexylresorcinol, a noncoagulant, is impaired greatly by the presence of serum, but that beechwood creosote, a coagulant, is limited but little in its action against test organisms by the presence of coagulated serum.[34]

Since these results seem so divergent from the reports of others with hexylresorcinol,[35] it would be interesting to theorize on the apparently greater efficiency of beechwood creosote in root canals. The phenol coefficient of hexylresorcinol is much higher than that of beechwood creosote, but, in root canals, a concentrated solution of the latter was used. The hexylresorcinol, on the other hand, was used in a 1:1,000 dilution. Furthermore, it is possible that the surface tension effect of the hexylresorcinol may have been detrimental in this case. This possibility is suggested by McCulloch[1] in his chapter on hexylresorcinol: "If sufficient débris is present, the amount of disinfectant ordinarily added may not be adequate to form a toxic film around all particles, and some bacterial cells may not be subjected to the disinfectant." The coagulating effect of the beechwood creosote, on the other hand, does not seriously limit its action.[34]

For Instruments.—For the sterilization of instruments, autoclaving (steam under pressure) is the most reliable method. Boiling for a sufficient length of time is the method of second choice.[25] Chemicals do not approach these methods in effectiveness. Therefore, whenever possible, autoclaving or sufficient boiling should be used. Chemicals are necessary if heat is contraindicated, as is often the case with keen-edged instruments, such as blades, burs and root canal broaches.

In considering the value of chemicals and the tests of their effectiveness for their use on instruments, an interesting question arises. Do we want instruments sterilized or are we satisfied to take a chance on a form of disinfection ignoring spores? I am in accord with Appleton's statement[36] to the effect that even though records of sporogenous infections in dental offices are rare, no method of sterilization can be considered satisfactory if it ignores the sporogenic types.

When a chemical is desired that can be relied on to sterilize instruments, none of the tests so far described is adequate. Brewer's[24] experiments should be studied by all dentists. This investigator found that the mercurial compounds so often used for the cold sterilization of instruments failed to kill *Cl. tetani, Cl. welchii* and *B. anthracis* spores in twenty-four hours. Results of Charlton and Levine[27] also demonstrated the difficulty of a quick destruction of spores. For the effect of any particular chemical on spores, as well as a treatise on disinfection and sterilization in general, McCulloch's[1] excellent book should be consulted. More tests with other chemicals along the lines of Brewer's[24] experiments are necessary before an accurate evaluation of chemicals capable of killing spores can be obtained.

If spores are to be disregarded, the F.D.A. special method *Staphylococcus aureus* 20° C. will give a fair evaluation of phenol or phenol-like compounds. The filter paper methods against *Staphylococcus aureus* may also yield interesting data, but the possibility of exaggerated results due to bacteriostatic action should never be disregarded.

It should be added that instruments thoroughly clean will be easier to disinfect or sterilize.

Probably the most difficult instrument to sterilize in the absence of heat is the dental handpiece. Appleton[36] writes that, if anhydrous liquids are to be employed, we must rely on thermal energy to kill the bacteria. If aqueous solutions are to be used, the same principles discussed for the disinfection or sterilization of instruments in general hold true, plus the additional fact that bacteria may enter the inner mechanism of the handpiece and be more difficult to reach.

The advertisements for chemicals to be used for the sterilization of handpieces may be misleading.[37] The germicidal efficiency of preparations containing oil should never be assumed simply because they contain a chemical with a high phenol coefficient.[1]

Finally, it should be realized that none of the results of standard tests for disinfectants are absolute guarantees that *Mycobacterium tuberculosis* has been killed.[1] This organism may not be a constant inhabitant of the oral cavities even in tuberculous cases. Still, the fact that the sputum may be heavily infested with the organisms should necessitate routine measures by dental practitioners to prevent any possibility of its spreading. This is another argument in favor of sterility of instruments.

SUMMARY

The standard phenol coefficient test and related tests are not designed primarily to give authoritative information as to what chemical should be used in every instance.

If the principles and limitations of the tests are fully understood and appreciated, the results of the tests yield valuable data.

More recent tests with chemicals against spores stress the need for more

experiments along this line and also the need for heat sterilization wherever possible.

The newer tissue toxicity tests offer interesting information relative to the use of antiseptics on tissues. These tests must give concordant results in the hands of different investigators before full dependence can be placed on them.

Accurate estimations of chemotherapeutic agents are not necessarily obtained by standard tests for disinfectants.

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ABSTRACTS OF FOOD AND DRUG ADMINISTRATION NOTICES OF JUDGMENT

Myraphen Tablets.—Plexo Preparations, Inc., New York. Analysis showed that the article contained not more than 1.98 grains of acetophenetidin per tablet. The article was misbranded in that it fell below the professed quality under which it was sold, namely, "Each Tablet contains 3 grs. Acetphenetidine." Further, the article was misbranded in that the package label failed to bear a statement that acetophenetidin is a derivative of acetanilid. Claims for the efficacy of the product in the relief of headaches, toothaches, neuralgia, neuritis . . . were adjudged false and fraudulent. (F. & D. No. 44559. June 1939. Cf. Notice of Judgment No. 29013, December 1938.)

Caulk Absorbent Points and Caulk Absorbent Cotton Rolls.—L. D. Caulk Co., Milford, Del. These products, which had been shipped in interstate commerce and which remained unsold and in the original packages at the time of examination, were found to be contaminated with viable micro-organisms. The articles were found misbranded in that claims for sterility appearing in the labeling were false and misleading when applied to articles that were not sterile. (F. & D. Nos. 44802, 44954, 44955. June 1939)

Cre-O-Tol. — American Proprietary Co., Inc., Malden, Mass. Analysis showed that Cre-O-Tol consisted of soap, water, coal tar neutral oils and phenols. Bacteriologic examination showed that Cre-O-Tol was not an antiseptic at a dilution of one teaspoonful to one quart of water. Claims for the usefulness of Cre-O-Tol as a treatment for aching feet, relief of swellings and soreness, as a treatment for cuts, wounds and burns, as a gargle and as a treatment for diseased gums were found false and fraudulent. (F. & D. No. 40806. June 1939.)

FEDERAL TRADE COMMISSION STIPULATION NO. 02447

The Federal Trade Commission accepted from Van De Mark Advertising, Inc., Times-Star Tower, Cincinnati, Ohio, a stipulation to discontinue misleading representations in the advertisement of "Floradex," a medicinal preparation distributed by Harold T. Maloney, trading as Floradex Company, Columbus, Ohio.

This is the third case in which an advertising agency has entered into a stipulation with the Commission to discontinue misleading representations in connection with the advertising copy of one of its accounts.

The agency agreed to cease disseminating advertisements which represent directly or by implication that "Floradex" is a treatment for constipation; is marvellous or new; will keep a person from being sick; will restore or build health; will enable one to gain vim and vigor, or that it is beneficial in removing the cause of most common ailments. The respondent further agreed to cease representing that constipation is the factor behind most human ills and ailments, and to discontinue the use of the word "food," or any similar words, in a way to imply that the preparation has any food value.

Harold T. Maloney had previously entered into a stipulation with the Commission in which he agreed to discontinue the practices in the same manner as set forth in this stipulation.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

Dentifrices*

Briggs Tooth Powder.—Composition: Each hundred grams is stated to contain powdered tricalcium phosphate (Monsanto), 10 gm.; calcium carbonate (Heavy, Industrial Chemical Sales), 40 gm.; powdered sodium chloride, U.S.P., 6 gm.; powdered sodium borate, U.S.P., 8.5 gm.; granulated sodium bicarbonate, U.S.P., 28 gm.; powdered castile soap, 5.25 gm.; soluble saccharin, 0.25 gm.; flavoring (menthol, thymol, oil of cloves, oil of cassia, oil of spearmint, oil of peppermint), 2 gm.

ABRASIVENESS: 6.6 mg. loss on a silver strip under 290 gm., when brushed 28,000 single strokes. (Details filed with Council.)

Manufactured by the Strong Cobb Co., Cleveland, Ohio. Distributed by Briggs Distributing Company, Cleveland, Ohio.

Selco Tooth Paste.—Composition: Each hundred grams is stated to contain glycerin, C.P., 31.43 gm.; soap, neutral, 6.66 gm.; powdered gum tragacanth, 0.5 gm.; soluble saccharin, U.S.P., 0.073 gm.; calcium carbonate precipitated (Snow Top Light), 42.85 gm.; mineral oil, U.S.P. heavy, 1 gm.; oil peppermint, redistilled, U.S.P., 1 gm.; water, q.s. 100 gm.

ABRASIVENESS: 0.0014 gm. on brass sheet, under 125 gm., in 4,500 revolutions. (Details filed with Council.)

Manufactured by The William A. Webster Company, Memphis, Tenn. Distributed by The Selig Company, Atlanta, Ga.

Kolynos Dental Cream.—Composition: Each hundred grams is stated to contain alcohol (absolute), 16.0 gm.; thymol, 0.019 gm.; saccharin, 0.33 gm.; oil of eucalyptus, 1.30 gm.; oil of peppermint, 1.40 gm.; benzoic acid, 0.30 gm.; glycerin, 27.50 gm.; soap, 20.0 gm.; precipitated calcium carbonate (Sturge No. 50), 32.98 gm.

ABRASIVENESS: 0.5 mg. on an antimony block under a weight of 63 gm. in 6,480 revolutions.

Manufactured by The Kolynos Company, New Haven, Conn.

Newco Dental Cream.—Composition: Each hundred grams is stated to contain gum karaya, 1.09 gm.; glycerin, 20.02 gm.; soap, 0.85 gm.; water, 33.03 gm.; saccharin (water soluble), 0.04 gm.; flavor, 0.73 gm.; chalk (Peerless, Medium Light), 30.04 gm.; magnesium carbonate, 5.86 gm.; hydrated magnesia 30%, 8.30 gm.

ABRASIVENESS: 4.75 mg. on antimony block under weight of 63 gm. in 6,000 revolutions (Peerless apparatus, A.D.R. 1939, p. 99).

Manufactured by Foreign Associates, Inc., Brooklyn, N. Y. Distributed by J. J. Newbury Co., New York, N. Y.

Milkident Dental Cream.—Composition: Each hundred grams is stated to contain precipitated calcium carbonate (Snow Top Light), 49 gm.; soap (U.S.P. castile), 1 gm.; tragacanth, 1 gm.; glycerin, 15 gm.; magnesium hydroxide, U.S.P., 1 gm.; magnesium carbonate, U.S.P., 1 gm., and water, 32 gm.; to which is added flavor (saccharin soluble, spearmint, cloves, cassia, peppermint, menthol), 1 gm.

ABRASIVENESS: 4.2 mg. on an antimony block under a weight of 63 gm. in 6,480 revolutions.

Manufactured by The Trade Laboratories, Inc., Newark, N. J.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information on the rules and work of the Council will be sent on request.

HAROLD L. HANSEN, *Secretary.*

*A.D.R. 1939, page 108.

President's Message

THE RELIEF FUND

THIS is the month of Christmas, the month in which every member of the American Dental Association, having received the Relief Fund Christmas Seals, is asked to make a contribution to the Fund. For this reason, this would seem to be an appropriate time to recall the purpose of this Fund and how it came into existence.

At the time of the San Francisco disaster in 1906, the American Dental Association raised by subscription from among its members the sum of $15,000 (in round figures) for the assistance of members in that stricken city. Of this amount, $11,000 was expended, leaving a balance on hand of $4,000, which was returned to the American Dental Association. With this in hand, the Association set out to raise a fund the income of which might be used at any time to assist needy members. Accordingly, a committee was appointed to formulate plans and, in 1913 (for the first time), Christmas seals were sent to the members, with the request that they purchase the seals for $1.00, or as much more as they cared to give. From that time, the Fund has steadily grown. In ten years, it had passed the $100,000 mark. In 1925, the first payment to needy members was made. Since then, more than $150,000 has been distributed to those of our co-workers who have fallen on evil days.

In 1935, a rule was adopted by which 50 per cent of the funds received from each state was returned to the state society to be used in assisting members in that state. At present, about $20,000 is being paid out each year by the American Dental Association. Last year, fifty-seven members from twenty-one states were given assistance. Applicants have varied in age from 29 to 89. More than half were under 60, many of them in their thirties or forties.

Of all the activities of the American Dental Association, none is more worth while than the Relief Fund. It is an activity in which every member is individually invited to participate, one in which you and I are given an opportunity to help our less fortunate brother practitioners. Each of us will have received by this time an envelope containing the Christmas Seals, with the request that we send $1.00 or more to headquarters at Chicago. A self-addressed envelope is inclosed for convenience in making returns.

With $1.00, we can as individuals do little to help those of our number who are in need, but if each of us sends in our dollar when we receive the seals, the total will aggregate $45,000. One half of this will be returned to the state societies from which the funds were received, to be used in giving assistance to needy members within that state. The remainder will be added to the American Dental Association Relief Fund. The income from this, added to what is already in hand, will bring gladness to many of our unfortunate members who, through no fault of their own, find themselves in want. We have it in our power to help them by the expenditure of no more than $1.00.

And may I pause at this point to say a word about our dental centennial and the commemorative seals which will come to you next month. Here is another opportunity for service. The Centenary celebration too has a claim on our generosity. The celebration in Baltimore promises to be the greatest event in the history of American dentistry. For a more detailed account of its program, see THE JOURNAL for November 1939, page 1894. We should all take pride in giving it our support.

It has been rightly said that we save that only which is given away in a good cause, that which is put to use where "moth and rust doth not corrupt, nor thieves break through and steal."

Two thousand years ago, the angels sang of peace on earth, good will to men. How strange these words sound in this closing year of 1939, when one half the world is in arms against the other half, when man's inhumanity to man transcends human imagination! Let us testify to our abhorrence of these things by our unselfishness in giving of ourselves and our substance to our less fortunate brother practitioners. They deserve our help. And will we not all have a happier New Year in feeling that we have had a part in bringing happiness and good cheer into the lives of others, in doing our part to hasten the day when the angel's song shall have found fulfilment in the lives of men?

Arthur H. Merrill

ASSOCIATION ACTIVITIES

SHOULD THE AMERICAN DENTAL ASSOCIATION'S DUES BE INCREASED?

AT the Milwaukee meeting, the Reference Committee, appointed to study the subject of the raising of the dues, recommended:

That the dues be raised $2.

That all state dental associations be urged to at once make such changes in their constitutions and by-laws as would authorize the additional $2 dues.

That the American Dental Association thoroughly acquaint its membership with the necessity for raising the dues.

That no action be taken at the Milwaukee meeting, but that action be deferred to 1940, at which time concerted action be taken to pass the proposed amendment.

The question of dues is certainly the most important and serious matter before the American Dental Association today. Final action thereon will determine whether the present activities of the Association can be continued on their present scale and, too, whether the scope of these activities can be extended to meet the constantly increasing demands of progressive expansion.

At the first meeting of the House of Delegates, in considering the advisability of an increase in the membership dues, L. M. Cruttenden (Minnesota) presented the following resolution:

WHEREAS, a resolution to amend Chapter IX of the Constitution and By-Laws of the American Dental Association was introduced and recommended by the Board of Trustees at the 1938 Annual Session in St. Louis, Mo., October 24-28;

WHEREAS, the proposal is for an increase of $2 a year in the dues paid by each member, and it is incumbent on the House of Delegates at the 1939 Annual Session to take some action on the proposal;

WHEREAS, this proposal is of the utmost importance to the dental profession in the United States, and the members of the House of Delegates and the membership of the American Dental Association are not fully informed regarding the need for such an increase in dues; and

WHEREAS, it would be beneficial to have an opportunity for open discussion and free debate upon the question and yet save as much time of the House of Delegates as possible; therefore, be it

Resolved, that the President of the American Dental Association appoint a committee to conduct an open hearing at the 1939 Annual Session in Milwaukee on the matter of raising the dues; that the committee be authorized to arrange for the time and place of such a meeting; that it be given the authority to require the presence of such Officers, Trustees and employes of the American Dental Association as they may desire; that they be further authorized to secure the help necessary to provide a stenographic record of the meeting, and that the attendance at such meeting be limited to members of the American Dental Association; and be it further

Resolved, that the committee submit a report of the findings in the form of a brief summary together with any recommendations that they may care to make to the House of Delegates at the 1939 Annual Session in

Milwaukee and that no vote be taken upon the merits of the proposed increase before the committee makes its report.

In the consideration of this resolution, the Budget and Finance Committee reported an unbalanced budget due to the increased expenditures and a motion was made and carried that the entire budget be cut 5 per cent.

The resolution was accordingly referred to the special Reference Committee, and the chairman, Vern D. Irwin, reported back to the House of Delegates as follows:

The special Reference Committee created by the House of Delegates and appointed by the President, Marcus L. Ward, to conduct an open hearing on the proposed amendment to increase the dues of the American Dental Association by the sum of $2, submits the following report and recommendations:

"The open hearing on the question was held in the Pere Marquette Room in the Schroeder Hotel between the hours of 3:30 and 6 p.m., Tuesday, July 18. Thirty-five members of the Association were present, including the entire Budget Committee of the Board of Trustees. The following state associations were represented officially or unofficially in the discussion of the question: Iowa, Massachusetts, Ohio, Illinois, Texas, North Carolina, Kansas, Arkansas, Colorado, Minnesota, California, Nebraska, Missouri, Tennessee and Wisconsin.

"According to the evidence, the delegates from four of these fifteen states had been instructed by their state associations to vote against any increase in dues; the delegates from one state were instructed to favor a $1 increase in dues; the delegates from eight states were not instructed; the delegates from two states were instructed to vote for the $2 increase in dues, provided the funds were used to finance some specific activity or increased function in the Central Office.

"These several suggestions made to the Committee are as follows: 1. A liberal appropriation to protect against unwarranted encroachment by state or national health schemes. 2. Unhampered activity of the necessary work of the standing committees of the Association. 3. Provision for the answer to our dental journal problem. 4. Provision for more educational and publicity work. 5. Provision for a full-time representative to look after the legislative interests of dentistry in state legislatures and the national capital. 6. Provision for a full-time director of professional relations in the Central Office, who will work for promotion, coordination and elevation of state association activities, and a general increase for a full-time Executive Secretary in the Central Office.

"The Budget and Finance Committee of the Board of Trustees submitted a detailed account of the sums requested by the various committees and departments of the American Dental Association and the amounts that the Budget Committee had allotted to these groups.

"The committee is of the opinion that the proposed amendment calls attention to a number of important questions and problems such as:

"1. Can the American Dental Association offer adequate protection to its membership from the influences now at work outside the Association and, at the same time, maintain the activities that the House of Delegates has approved in the past years?

"2. Can cuts in the budget be made, based on no increase in dues, without seriously hampering the essential activities of the Association or without dipping too deeply into the reserve funds of the Association?

"3. Is the problem of increasing the dues $2 a truly economic and serious handicap, or is it largely a psychologic hurdle for our members to consider?

"4. If there is actual need for a $2 increase in dues as proposed in St. Louis by the Board of Trustees, is it wise to compromise on a $1 increase?

"5. Can the American Dental Association and its component societies meet the demands created by the changing social tendencies and, at the same time, respond to the desire for increased activities and services from the general membership without raising its dues?

"The Committee is of the opinion that the membership desires to continue the present activities of the Association, and that these activities will naturally expand in the future as the profession responds to public needs.

"The Committee is of the opinion that if an increase in dues is voted, there will be no greater loss of membership from a $2

increase than from a $1 increase, because it is convinced that, in the final analysis, the problem is not nearly so great an economic one with the rank and file members as it is a pyschologic problem with those members and their leaders. It is only natural to resist death, dues and taxes.

"In view of the needs of the Association, as expressed in the plans and demands of its Officers, committees and members and the general public, the Committee is of the opinion that the dues of this Association should be raised $2, as provided by the proposed amendment.

"However, if this amendment is adopted this year, many state dental associations will have to pay the increase out of their own treasuries because they have made no provision in their constitution or by-laws to collect additional revenue from their own members. We also recognize that a great deal of work will have to be done by the American Dental Association and its component societies to acquaint the general membership with the necessity for such an increase in dues.

"The Committee therefore recommends that:

"1. All state dental associations and component societies be urged at once to make such changes in their constitution and by-laws as will authorize those organizations to collect an additional $2 dues for the American Dental Association.

"2. The American Dental Association and all component societies carry out a plan to acquaint the general membership of the Association with the recommendation.

"The Committee is of the opinion that the question of raise in dues should not be voted on at this session.

Respectfully submitted,
T. A. HARDGROVE,
PAUL H. JESERICH,
H. E. KING,
GEORGE B. WINTER,
V. D. IRWIN, *Chairman.*"

Dr. Irwin moved that action on the proposed amendment be deferred until the next Annual Session, which is to be held in 1940.

The special reference committee, at the opening hearing provided in the original resolution, gave exceedingly fair and judicial consideration to the question of increasing the dues and embodied in its report suggestions for action by the various state societies preparatory to final action on the question at Cleveland.

As there seems to be much doubt in the minds of many members as to the desirability of such a proposed increase in dues and the purposes for which the increased income is to be used, the following cogent reasons for increase of the dues are presented.

Nearly all of the activities of the Association noted below have increased largely in scope and expense during the past several years, and in order to meet the constantly increasing demands upon the income of the Association created by the enlarging of the membership and the scope of such a large and important organization, it is urgently necessary that the income keep pace with the increase in expense. Pursuant to the demands for an extension of the scope of the Association in its efforts to enhance membership in the organization and to serve better the interests of the individual members, the following projects have been proposed, each of which means an increase in expense.

1. Recommendations have been made to employ a full-time director of professional relations in the Central Office, who will work for promotion, coordination and elevation of state association activities and those of their component societies. This will necessitate additional salary, clerical help and travel expense.

2. Recommendations have been made for a full-time secretary for the Council on Dental Education. This will require additional salary, clerical help and travel expense.

3. Recommendations have been made to employ a secretary of the Legislative Committee. This will require salary, help and travel expense. In view of the present and proposed social changes, the activities and duties of the Legislative Committee must be increased.

4. Recommendations have been made for increased activities of the Economics Committee. Social changes necessitate this move, which will increase A. D. A. expenses.

A large part of the foregoing activities have been carried on in the past by volunteers in the organization. Members of these various committees have donated their time, services and even money to serve dentistry. A. D. A. needs have grown so large that its business can no longer be conducted by volunteer services; nor is it proper that a certain few men should carry the load for organized dentistry as a whole.

5. Recommendations have been made to increase research activities, certainly a much needed and worthy project. The Research Commission and the Council on Dental Therapeutics are doing excellent work, but not enough. Money is badly needed to enable them to carry on to the fullest extent.

6. Recommendations have been made that we employ a full-time Secretary, which will necessarily increase the expense of the Central Office.

7. The activities of the A. D. A. have increased so greatly in recent years that the Business Manager's office must soon be augmented with additional help in

Expense Items—1928	*Expense Items—1938*
Secretary-Business Manager	Secretary-Business Manager
Journal	Journal
Annual Sessions	Annual Sessions
Bureau of Public Relations	Bureau of Public Relations
Bureau of Chemistry	Council on Dental Therapeutics
Library Bureau	Bureau of Chemistry
Treasurer	Library Bureau
President	Committee on Membership
Board of Trustees	Treasurer
Budget and Finance Committee	President
Relief Commission	Board of Trustees
Research Commission	Budget and Finance Committee
Committee on Dental Index	Relief Commission
Dental Educational Council	Relief Fund Committee
Committee on Legislation	Research Commission
Judicial Council	Committee on Dental Index
	Dental Educational Council
	National Board of Dental Examiners
	Committee on Legislation
	Judicial Council
	Committee on Nomenclature
	Committee on Economics
	National Museum Committee
	Committee on Dental Health Education
	Committee on Women's Auxiliary
	Public Health Committee
	American Association for Advancement of Science
	Insurance Committee

Total expense items in 1938	28
Total expense items in 1928	16
Increase in expense items	12

order to handle the bookkeeping and other necessary activities resulting from this increase.

8. Recommendations have been made for the A.D.A. either to publish an additional journal or to increase the contents of the present journal. This will require additional personnel in the Editorial Department and a decided increase in editorial and printing expenses.

9. Recommendations have been made to greatly increase the lay educational program. More and better radio programs are desired. Additional newspaper and magazine publicity is needed. Additional motion pictures are very badly needed.

Recommendations have been made to employ a well-trained person for lay educational work, one who would enable us to develop more and better educational material for school use. These are all worthy projects and are much needed, but it will require considerable money in order to put them into effect.

10. Recommendations have been made to increase the services and activities of the Library Bureau. This will require not only additional personnel, but also additional space, as the present library is greatly overcrowded.

11. Recommendations have been made to improve and enlarge the Scientific and Health Exhibits. Also, recommendations have been made for employment of a full-time director of exhibits, whose duties would consist of developing exhibits for the national and state meetings and for the use of all organizations interested in dentistry. This is a much needed service, but additional funds will be required to finance it.

12. The present activities of the Association are so great and the personnel so large that the Central Office is badly overcrowded. If these newer activities are added, additional space must be acquired. The Association must definitely look forward in the near future to enlarging its headquarters space. This naturally will require considerable sums.

The accompanying statement shows very graphically that the Association activities have increased from sixteen in 1928 to twenty-eight in 1938.

This increase of twelve expense items has benefited our members and dentistry as a whole at no increase in membership dues. It has been made possible by the increased income derived from increased membership during that period, from the income from judicious investments and by good management.

The American Dental Association has now reached the point where it will be impossible to expect much increased income from new members; nor can a much increased income be expected from investments or from the sale of advertising. Therefore, in order to put into effect the twelve recommendations listed above, which have been made by members, it will be necessary to increase the dues to defray the additional expense.

During the past year, the Association has been called upon to make appropriations of $5,000 for a dental exhibit at the Golden Gate Exposition at San Francisco; $10,000 for the New York World's Fair Exhibit, and $10,000 for the promotion of the proposed Centenary Celebration of the foundation of dentistry to be held in Baltimore in March 1940.

These appropriations and the normal increase in operating expenses have made it necessary to dispose of reserve funds of the Association. Increase in necessary activities will continue to encroach constantly upon the reserve.

It is hoped that the various state societies will take the necessary steps to provide for an increase in dues and that all state delegations will be instructed to support the proposed increase in dues, to the end that the American Dental Association may continue to increase its activities as befitting the increasing importance of dentistry as a health service to humanity.

COUNCIL ON DENTAL EDUCATION

REPORT OF THE COUNCIL ON DENTAL EDUCATION TO THE PRESIDENT, THE TRUSTEES AND THE HOUSE OF DELEGATES OF THE AMERICAN DENTAL ASSOCIATION

THE Council on Dental Education was fully organized and the membership from the Examiners Association ratified at the St. Louis meeting in October 1938.

The enabling act establishing the Council on Dental Education was amended at the request of the Council by the House of Delegates of the American Dental Association at its meeting in St. Louis. To meet the conditions that may follow the change in title, the words "Successor to the Dental Educational Council of America" were added. This, it is believed, will meet any questions of law that may arise in those state dental acts carrying the former title. The committees on history, museum and nomenclature were also removed from the jurisdiction of the Council.

The Council requested of the Board of Trustees an appropriation of $7,650 to meet its anticipated budget for the fiscal year of 1938-1939. About $4,200 of this amount has been expended. An appropriation of $13,500 is being requested for the fiscal year 1939-1940. Included in this budget is the salary of a permanent secretary and the expense of operating the Council's office in the Central Office of the American Dental Association.

Although provision was made in the enabling act for a permanent secretary, the Council felt that this expenditure was not necessary until certain preliminary work had been completed. Minor J. Terry has acted as secretary pro tem. and has carried out the duties of this office, which have increased until now a permanent secretary is not only necessary, but also imperative.

The main topic of discussion during the early meetings was the compilation and publishing of a preliminary statement which would present the aims and objectives of the Council, a philosophy of dental education and entrance requirements. The Council felt it urgent to establish and publish a statement outlining the required study for entrance to the study of dentistry. After hours of debate and discussion, supported by consultation with leading educators and educational bodies, the Council published and distributed its first statement at the time of the meeting of the American Association of Dental Schools. Copies of this statement were forwarded also to the Board of Trustees and to boards of dental examiners. This statement was published in THE JOURNAL for May 1939.

The requirements for admission to the study of dentistry become effective for the year 1941-1942. This will give prospective dental students time to prepare themselves for admission to dental school, and there will also be ample time for the schools to arrange their curricula to meet the new requirements.

The chairman and Leigh C. Fairbank, brigadier general of the U. S. Army Dental Corps, were delegated as a committee to outline a course for dental interns in hospitals. The Council contemplates the accreditation of hospitals made use of by the dental schools in which internships are offered, and also those hospitals and

order to handle the bookkeeping and other necessary activities resulting from this increase.

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infirmaries where such internships may be established.

A committee of one has been appointed by the Council to investigate and recommend procedures for the next step in evaluating the curricula in dental schools.

At its Cleveland meeting in March, the Council adopted certain detailed specifications and qualifications to be required of a permanent secretary.

At the March meeting, it was also voted that the Council on Dental Education request the American Association of Dental Schools to study the problem of organizing on a national basis aptitude tests for use in the selection of students for admission to dental study.

The Council plans to continue the publication of the dental students' register as in the past.

In the May issue of THE JOURNAL, the first statement of the Council set forth the aims and objectives, as well as a statement of policy, principles and a preliminary statement of criteria, which will be elaborated and developed from time to time. Attention is directed to the editorial on the work of the Council which appeared in the same issue.

At the February 12-13 meeting, it was decided by the Council that monographs should later be prepared on various phases of dental education for publication in THE JOURNAL.

During the coming year, the Council will develop criteria and a method of accreditation. The accreditation of schools will begin as soon as the Council deems it advisable. The schools will be granted a period of adjustment after the publication of the criteria and method of accreditation.

The most important problem now confronting the Council is the selection of a permanent secretary. The Council has canvassed the entire United States in its search for a man qualified to fill this important position. It is also necessary that such a man be available for . . . service exclusively. An appeal was sent to all deans of dental schools and several educators of national prominence. Conferences have been held with applicants, and some very promising men are under consideration, but the Council has not decided on a nomination for this position. It hopes to be able to submit a name to the Board of Trustees at an early date.

The Council on Dental Education is now affiliated with the American Council on Education, paying annual dues of $100. The Dental Council was represented at the meeting of the American Council on Education in Washington April 8, and participated in the discussion with reference to accrediting agencies. While accrediting agencies on the whole received some criticism, it was conceded that professional accrediting bodies are justified in that professional education has definite objectives and the problems are different from those of general education.

The Council has established a committee on foreign relations, and this committee is making a study of conditions in foreign dental schools affecting dental education in this country. A report will be made from time to time.

LEROY M. S. MINER, *Chairman,*
MINOR J. TERRY, *Secretary Pro Tem.*

The Council is planning to formulate for publication a criterion which shall be used as a "yardstick" for evaluating the course of study offered by the dental schools of the country. This criterion is to be completed and published not later than January 1941. The inspection of the various schools for the purpose of accreditation will then begin about a year later, or 1942. This will give the schools time to digest the content of the criterion and adjust their curriculum accordingly.

THE DENTAL SERVICE OF THE ARMY

By Leigh C. Fairbank,* Washington, D. C.

MANY inquiries are received daily concerning the dental service of the Army. Information is desired relative to applications for commission both in the Regular Army and in the Reserve, relative to active duty for Reserve Officers and relative to many personal matters. Many of these letters indicate a patriotic spirit typical of our citizens. Replies to these inquiries may seem rather vague, and, for this reason, a general statement at this time seems to be desirable for the entire membership of the American Dental Association.

At the present time, the Dental Corps of the Regular Army is being increased. Examinations are usually held in February and August of each year. The applicant must be a male citizen of the United States, between the ages of 23 and 32 years, a graduate of an acceptable dental school legally authorized to confer the degree of doctor of dental surgery or doctor of dental medicine; have a commission in the Dental Reserve Corps, and be physically fit for service as shown by a careful physical examination. Candidates must also have been engaged in the practice of their profession for at least two years subsequent to graduation. They are required to undergo a rigid professional examination at the date of examination. Reserve commissions are tendered those who successfully pass the professional and physical examinations, whereupon they are then commissioned in the Regular Army. Application for authority to take the examination should be submitted direct to the Adjutant General of the Army, Washington, D. C. Full information concerning the Dental Corps and the entrance examination will be furnished by the Surgeon General, U. S. Army, Washington, D. C.

At the present time, the Dental Reserve Corps consists of more than 5,000 civilian dentists, many of whom have maintained their Reserve Corps status since the World War. The Reserve must furnish a certain proportion of various specialists and men with qualifications required for a very broad and extensive dental service in event of mobilization requiring a large dental corps. More than a year ago, appointments in the Reserve were suspended pending some necessary changes and classifications. However, an exception has been made to this ruling in the case of those who desire a reserve commission and extended active duty with the Regular Army. Those applying for reserve commissions under this provision must submit a special application, form for which can be secured from the Surgeon General, Washington, D. C. Selection is limited to applicants not over 30 years of age who, upon careful investigation, are found to be suitable for the Regular Army, and who will meet the eligibility requirements for appointment in the Dental Corps upon completing a period of active duty. These candidates are commissioned only when they are needed for this extended active duty, which is for a period of at least one year. An opportunity will be given these newly commissioned reserve officers to take the Regular Army examination.

The annual pay of officers of the Dental Corps upon entry into the service is $2,000 plus $96 a month for subsistence and quarters for an officer who has dependents, and $2,000 plus $58 a month

*Brigadier General, United States Army Dental Corps.

for subsistence and quarters if there are no dependents. The rental allowance is given only when quarters are not furnished by the Government. The amounts stated are increased after each three years' service thereafter and upon each promotion to a higher grade, until the maximum of $7,200 for the grade of colonel with twenty-six years' service is reached. The same pay schedule applies for regular and reserve officers when on active duty.

Possible expansion of the Army to the authorized peace strength has prompted the following letter to the deans of the dental colleges:

October 25, 1939.

Dear Dean:

Should there be an expansion of the Army, increasing our military force to the full authorized peace strength provided by the National Defense Act, there would be a marked increase in the Dental Corps. This increase would be effected by the gradual assignment of selected dental reserve officers to extended active duty.

For over a year, appointments in the Dental Reserve have been suspended. Exception is now provided for the appointment of those desiring extended active duty and those expressing a desire to take the competitive examinations for the Regular Army, who are professionally, physically and morally qualified for commission.

We are particularly anxious to secure men whom you can recommend as highly qualified for the Dental Corps. Duty will be largely confined to hospitals and dispensaries. Applicants who meet our requirements will be commissioned in the grade of 1st lieutenant.

It is requested that you cooperate with this office in making these selections, by recommending young graduates of your school who meet the following initial personal requirements:

1. Member of the American Dental Association.
2. Calm, courteous, pleasant manner.
3. Neat and dignified presence.
4. Capable and above average ability.
5. Excellent character.
6. Keen and careful mentally.
7. Earnest and cooperative disposition.
8. Precise and thorough in application to duty.
9. Well grounded intellectually.
10. Holds no religious or political convictions detrimental to service with the United States Army.

If you will kindly submit the names and addresses of several of your recent graduates who might be interested, it will be greatly appreciated.

For The Surgeon General:

LEIGH C. FAIRBANK,
Brigadier General,
Medical Department (DC).

To augment the dental service and to provide suitable candidates for appointment in the Dental Corps, Regular Army, dental internships were provided in 1938. Subject to rigid rules, the selections and appointments are made for a limited number of graduates annually. Their assignment becomes effective July 1 following graduation. Interns are assigned to general hospitals where a broad dental training is provided. The internships are for one year only.

Upon successfully completing the internships and passing the physical examination, the interns are commissioned in the Dental Corps, Regular Army, without the usual professional examination. These interns receive a salary of $60 a month plus maintenance. Applications for internships are received by the Surgeon General only when submitted with the approval of the dean of the applicant's school. The deans will be notified when applications will be received.

While the Army offers an interesting career, including travel and many social advantages, the possibilities for achievements in dentistry make it particularly desirable today. The opportunities for advanced education and training, for research and for broad clinical experience make possible unlimited professional advancement.

The Medical Department, of which the Dental Corps is a part, has a history of great accomplishment. Under its in-

spiring direction and with its cooperation, the Dental Corps is rapidly growing and developing into a distinguished dental health agency, designed to render an efficient service to our peace-time Army and to expand into a very large dental service to meet war-time needs.

Only the highest quality of dental service is acceptable in the Army. Every dental officer must have an educational and professional background which will assure the Army the finest group of dental officers and the highest type of dental service.

THE PROPOSED NEW PLAN OF DENTAL EDUCATION AT HARVARD

DURING the past year, a Harvard University committee has been studying the problems of dental education. The report of this committee has been considered by the faculty of medicine and by the university administration.

No official statement regarding the suggestions of the committee has yet been released. Nevertheless, various accounts, based entirely upon rumor, have appeared. It is unfortunate, both for the Harvard Dental School and for dental education, that many irresponsible and misleading statements have been made which, in large part, are without foundation in fact.

It is not possible to release the details of the plan which has been formulated at this time, but it is expected that a full account of it will be made public not later than January 1. In the meantime, the following observations may serve to correct some of the many misapprehensions that now exist.

1. Harvard is not "going to end its dental school after seventy years."

2. It is not true that, beginning this fall, the Harvard Dental School will cease to exist. As a matter of fact, the Harvard Dental School did accept this fall the usual first year class, with a full quota of students, and will carry this class through the entire four years under the present framework.

3. There is no truth in the statement, as applied to the present situation, or to the contemplated new plan, that "all candidates contemplating the study of dentistry must first enroll and qualify by acquiring the degree of doctor of medicine, before entering upon the study of dentistry."

4. The statement that the objective of the new course in dentistry will be not to train men for the general practice of dentistry is misleading. Whatever new plan is adopted, it will still be possible for men to qualify for general dental practice and to satisfy requirements for licensure.

5. The statement has been made that Harvard is going to discontinue teaching prosthetic and other forms of restorative dentistry and confine itself simply to preparing men for oral surgery and other specialties. Again, this is wholly without foundation in fact.

6. The dental profession may rest assured that any modifications in the curriculum now under consideration will, if put into effect, be expected to elevate the importance of dentistry as a profession, and neither to lower its standards nor to diminish its effectiveness.

7. Until a full account of the plans of the new course has been presented officially, we ask the many who are interested in the Harvard Dental School and in the progress of dental education to delay judgment.

LEROY M. S. MINER, *Dean,*
Harvard Dental School.

DENTAL HEALTH SURVEY IN ST. PAUL SCHOOLS 1938-1939*

DURING the 1938-1939 school year, a dental health survey was made of 20,529 children in the elementary schools of St. Paul. All but four of the sixty-four schools of the city were included in the project. Examinations were made by members of the St. Paul District Dental Society who volunteered to do the work.

Each child who was examined was put into one of four classifications based upon the amount of dental attention needed. The results of this classification are shown in Table 1.

Follow-up inspections are conducted by the oral hygienists and their W.P.A. assistants throughout the year. The most intensive work is confined to the grade schools. Table 2 shows the percentage of children who received professional attention during the year.

TABLE 1.—CLASSIFICATIONS BASED ON DENTAL CARE NEEDED

Class	No. of Children	Percentage	
A	5,789	28.2	(No dental attention necessary)
B	8,845	43.09	71.8% dental care recommended
C	4,288	20.89	
D	1,607	7.83	

TABLE 2.—CHILDREN RECEIVING DENTAL CARE

Grade	Children Who Received Professional Attention Per Cent
Kindergarten	33.09
First	46.34
Second	48.90
Third	50.39
Fourth	51.15
Fifth	56.46
Sixth	53.49
Seventh	47.73
Eighth	45.25
Special classes	
Crippled children	59.18
Average	48.32

The responsibility of recording and follow-up work was assumed by the local parent-teacher association of each school, and they were assisted by teachers, oral hygienists and school nurses.

This average (48.32 per cent) compares very favorably with the 1937-1938 average of 42.55 per cent of the children having received professional attention. The financial investigations were conducted by the oral hygienists with the help of various workers on the W.P.A. project. Children whose parents were

*From the report of the director of hygiene to the commissioner of education and the superintendent of schools.

unable to pay for private dental service were referred to the nine dentists on the W.P.A. project. These nine dentists completed the care of 2,392 cases and performed 15,597 operations during the year while working on a part-time basis.

POSTGRADUATE SEMINAR IN CHILDREN'S DENTISTRY SPONSORED BY THE TENNESSEE STATE DENTAL ASSOCIATION AND THE DEPARTMENT OF PUBLIC HEALTH, STATE OF TENNESSEE

A FIFTEEN-WEEKS postgraduate seminar in children's dentistry, sponsored by the Tennessee State Dental Association, and the Tennessee State Department of Public Health, has just been completed. This course, which is one of the most extensive undertaken by any state, was enthusiastically received and well attended. Approximately 425 dentists registered for the course.

Five weeks was devoted to each of three districts for a total program duration of fifteen weeks. Each district was subdivided into three district centers, where the series of five lecture-clinics were held on Mondays, Wednesdays and Fridays, respectively.

Each class period consisted of lectures from 10 a.m. until 12 m. After a recess of one hour for lunch, the class assembled for open discussion and table clinics until 3 p.m. The remainder of the afternoon and the following morning were devoted to office consultation and chair demonstrations.

Ralph L. Ireland, professor of children's dentistry at the University of Nebraska, College of Dentistry, was the instructor for the course, and he was assisted by Walter J. Pelton, Passed Assistant Dental Surgeon of the United States Public Health Service.

OREN A. OLIVER, *Vice Chairman,*
Public Health Council,
Department of Public Health,
State of Tennessee.

NATIONAL HEALTH PROGRAM COMMITTEE

COPIES of the "Complete Report of the National Health Program Committee" are available to members on request to the National Health Program Committee, 212 East Superior St., Chicago.

The pamphlet includes the statement made by the Committee on the Wagner Health Bill, the testimony before the Senate subcommittee and the tentative plan adopted by the House of Delegates at Milwaukee for the participation of dentistry in a national health program.

COMMITTEE ON LEGISLATION

DUTY AND RESPONSIBILITY OF DENTIST IN MAKING DIAGNOSES

By LESLIE CHILDS, Indianapolis, Ind.

AS a general rule, the duty and responsibility of a dentist in making a diagnosis is measured by the standard of practice in his locality. And here, a mistake in itself will not, as a matter of law, render him liable for a disappointing result in the treatment he resolves upon.

On the other hand, where a mistake in diagnosis is grounded on negligence, or a failure to exercise care and skill, measured by the recognized canons of practice, a dentist may be called upon to respond in damages where injury results. For illustration, let us examine Eatley vs. Meyer, 10 N. J. M. 219, 158 Atl. 411.

FACTS IN THE CASE

In this case, the plaintiff, a woman, went to a young dentist, had several teeth extracted, and was instructed to return the following day for additional treatment. The plaintiff did not obey instructions, and did not return until *six* days later. At this time the dentist discovered a serious condition because of which the plaintiff could not open her mouth. In this situation, she was sent for treatment to the defendant, who held himself out as a "Dental Specialist, X-rays."

The defendant, after an examination, made a diagnosis of broken jaw. He took two x-ray negatives, which, it seems, were not very satisfactory, wired the teeth and sent the plaintiff home. That night she suffered great pain and called in a physician. The latter decided that there was infection. Overnight, the plaintiff's condition became worse and the following morning the physician sent for the defendant for a consultation.

The physician stated that he believed there was an infection and requested the defendant to remove the wires, but the defendant refused to do this, insisting that the jawbone was broken. The plaintiff's temperature continued to rise; other physicians were called in, and more consultations were held. Finally, with the plaintiff growing worse all the time, the defendant consented to remove the wires. A serious infection was disclosed, but the jawbone was not broken, and plaintiff recovered in due time.

The instant suit for damages against the defendant followed, based upon his alleged wrongful diagnosis of the plaintiff's condition when she first applied to him. The plaintiff received judgment for $1,200 in the lower court. The defendant appealed, and the higher court, in reviewing the record and in affirming the judgment, reasoned, in part, as follows:

WHAT THE COURT DECIDED

After three days of disputations, during which defendant adhered tenaciously to the broken jaw diagnosis, he consented to remove the wires, and the subsequent examination disclosed an extensive infection, which cleared up under appropriate treatment. Several x-rays . . . showed there was no fracture,

and from her [plaintiff's] testimony it would appear that the x-ray taken by defendant afforded no support for such a diagnosis.

Not only this, but the testimony justified a finding that defendant not only wrongly diagnosed and treated, but obstinately refused to acknowledge his error, and seriously endangered the life of his patient, not to speak of causing her several days of severe suffering. Plaintiff's counsel argues, and correctly as we think, that the defendant, as a specialist and claiming to be an expert, was held to a higher degree of care and skill than the ordinary practitioner. . . . We find no harmful error, and the judgment will accordingly be affirmed.

However, as noted in the beginning, a mere error of judgment by a dentist in making a diagnosis will not, in itself, support a judgment in damages for a resulting injury. In addition, there must be a showing of negligence or a failure to exercise ordinary care and skill; and, as a usual rule, this may only be proved by expert testimony. The application of this rule is illustrated in Rising vs. Veatch, 117 Cal. App. 404, 3 Pac. (2d) 1023.

TOOTH EXTRACTED—INFECTION FOLLOWS

Here the defendant, a dentist, extracted an impacted tooth for the plaintiff, a woman. The plaintiff was then given some medicine to use at home, and instructed to return to the defendant's office the following day. The next day, the plaintiff's jaw was swollen, and her husband called at the defendant's office to inform him of this, but the defendant was not in. However, a nurse in the defendant's office was contacted and informed of the plaintiff's condition, and this was held binding upon the defendant for the purposes of this case.

The plaintiff's condition became such that a physician was called, and he found the plaintiff suffering from an infection that had its beginning in the wound in the mouth from which the tooth had been extracted. The plaintiff suffered severely, but a cure was finally effected, and the instant suit against the defendant for damages was filed.

This action was grounded upon the defendant's failure properly to diagnose the plaintiff's ailment and treat her, after being informed of her condition via the message to the nurse in his employ. The plaintiff submitted evidence of the foregoing facts, but did not show by expert testimony that the defendant's failure to treat her was a violation of professional duty. Judgment, however, went for the plaintiff. On appeal, the higher court, in reviewing the record and in reversing the judgment, reasoned:

THE LANGUAGE OF THE COURT

As we view it, the case . . . presents two questions: (1) Having in view the prevailing standard of skill and learning of dentists in the same locality, in the exercise of ordinary care should appellant [defendant] upon being informed that his patient's jaw was swollen and her lower jaw and neck discolored, have from that information diagnosed the condition as one needing further or different treatment from that which he had already prescribed for use at home by the patient? (2) Was there, in view of the prevailing standard of practice among dentists in the locality, any positive duty upon appellant to visit the patient in her home?

We cannot close our eyes in the consideration of the second question to the fact that dentists are primarily office practitioners, and that it is the common practice at least for them to treat patients in the office and not elsewhere. On neither of these questions was there any expert testimony given. . . .

On the first question, for aught that appears from the testimony, a dentist of the prevailing skill and learning of dentists generally in the community might in the exercise of ordinary care have concluded that the treatment which he had already prescribed was sufficient to meet the conditions described by the husband to the nurse. "A physician is not held to a higher degree of responsibility in making a diagnosis than in prescribing treatment. . . ."

When due care, diligence, judgment, and skill are exercised, a mere failure to diagnose correctly does not render a physician liable.

. . . A mistake in diagnosis in the present case was alleged and proved, and is conceded to have taken place. But it was not only necessary for the plaintiff to prove such mistake, but also that the mistake was due to failure to exercise ordinary care, diligence, and skill in making the diagnosis. . . . Mere proof that the diagnosis was wrong would not support a verdict. . . . The judgment is reversed.

Another interesting case, which at least borders on the field of diagnosis and which strikingly illustrates the general rule that neither a physician nor a dentist may be held liable merely on the grounds of an unfortunate result was Brown vs. Hughes, 94 Colo. 295, 30 Pac. (2d) 259. The case involved both a physician and surgeon and a dentist.

JOINT OPERATION PERFORMED

Here, after placing the patient under a general anesthetic, the defendant physician and surgeon performed a tonsillectomy. Following this, the physician attended to the anesthetic and the defendant dentist extracted sixteen teeth. The operation consumed about two hours, after which the patient went to his home in the country. Soon thereafter, he was in a serious condition.

The physician was called and attended him until his death, a short time after the operation. The death certificate recited the cause as "chronic myocarditis with chronic tonsillitis and abscessed teeth as contributing causes."

Following this, the plaintiff, widow of the deceased, brought the instant action for damages against both the physician and the dentist. The gist of the action was a charge that the defendants had been negligent in the performance of this double operation, in view of the physical condition of the patient.

At the trial, there was some conflict in the expert testimony *re* the advisability of extracting as many as sixteen teeth at a time, coupled with a tonsillectomy. But, in the main, this testimony was to the effect that this was a subject for the judgment of the physician and the dentist, based on their observation and examination of the patient.

The case went to a jury on the conflicting evidence, and the latter returned a joint verdict against both defendants for $5,000. The defendants appealed, and the higher court in reviewing the record and in reversing the judgment said:

THE REASONING OF THE COURT

The record discloses that there is no dispute between the parties hereto concerning the technique of the two operations that were performed while the patient was under one general anesthetic. . . . The qualifications of the defendants are not questioned. In its true sense, the only question ultimately disclosed by the entire record in the case is:

Did the defendants use bad judgment and follow improper practice, and thereby negligently subject their patient to extreme danger and cause his death by performing both operations at one and the same time and, more especially, the extraction of more than two or three teeth at the same time? . . .

There is evidence that the practice followed by defendants herein had been successful in similar cases in medical and dental history, and none that it had not. The general substance of the testimony of plaintiff's witnesses on this question was to the effect that the particular witness did not consider it advisable practice, some saying they would not have pulled more than two or three teeth at this time, or on the first extraction, but the majority of plaintiff's expert witnesses concluded that such matters were to be left, as in all cases, to the best judgment of the operator. . . .

The burden was on plaintiff to show that the acts of the defendants complained of were the direct cause of death. The fact that there was a lamentable result is not of itself evidence of negligence on the part of the defendants. There is no evidence in this case which would support a verdict that death would not have otherwise ensued. The burden is not met by showing that it might have resulted from the operations complained of, and jurors should not be left to conjecture

as to the efficient and proximate cause. . . . The judgment is reversed.

SUMMARY

The foregoing cases constitute fair examples of the reasoning followed by the weight of authority on the question of the duties and responsibilities of dentists in making diagnoses. And here we find that a dentist will not be held to a higher degree of care in making a diagnosis than is imposed upon him in treating his patients and, likewise, is measured by the standard of practice prevailing in his vicinity.

And, as illustrated in the cases herein reviewed, an error in making a diagnosis will not, of itself, subject a dentist to liability; for such, standing alone, will not constitute proof of negligence. On the other hand, where the error, measured by recognized standards, discloses negligence—a failure to exercise ordinary care and skill—liability for resulting injury may accrue.

1520 East Tenth Street.

A PERIODONTIA SPECIALTY CERTIFICATION BOARD

At the time of the meeting of the American Dental Association in Milwaukee, in July, two new boards were formed relating to dental specialties. The first was the American Board of Periodontology, organized by the American Academy of Periodontology to examine and certify dentists who have become proficient in the science and art of periodontology. A secondary purpose which is fully as important as the primary one is to encourage the study and promote the practice of periodontology through setting up standards and stimulating the development of graduate work in the universities for the preparation of candidates. The members of the Board are Dickson G. Bell, San Francisco, Calif.; M. Monte Bettman, Portland, Ore.; Austin F. James, Chicago, Ill.; Olin Kirkland, Montgomery, Ala., and Harold J. Leonard and Arthur H. Merritt of New York, N. Y. Dr. Merritt is chairman, Dr. Kirkland vice-chairman and Dr. Leonard secretary-treasurer.

Recognized periodontists of ten years' or more standing will be given an examination on the basis of their education and attainments, together with such special examination as the board may designate. It is planned that the candidates after 1945 must have taken a graduate school course in appropriate subjects leading to a master's degree or its equivalent as part of their preparation for examination.

It is not the intention that certified periodontists shall, as is required in some other specialties in dentistry and medicine, necessarily limit their practice exclusively to periodontia in order to be maintained on the roster of certified periodontists.

"DENTAL CARIES" MONOGRAPH

Copies of the monograph on "Dental Caries" published by the Research Commission of the American Dental Association, and reviewed in the November issue can be procured from the Secretary of the Commission, Dr. Daniel F. Lynch, 2651—16th Street, N. W., Washington, D. C., at $1.00 per copy.

DENTAL CENTENARY CELEBRATION

SCHEDULE OF HOTEL RATES

BALTIMORE, MD., MARCH 18, 19, 20, 1940

Hotels	Single	Double
*ABBEY, 723 St. Paul St.	$1.00 – 2.00	$2.00 – 3.00
ALTAMONT, Eutaw Place & Lanvale Sts.	2.50 – 3.00	3.00 – 4.00
ARUNDEL, Charles St. & Mt. Royal Ave.	2.50 – 3.00	3.00 – 4.00
*BALTIMOREAN, 2905 N. Charles St.	3.00	4.00
BELVEDERE, Charles & Chase Sts.	3.50 – 7.00	5.50 – 9.00
*BILTMORE, Fayette & Paca Sts.	2.00 – 2.50	3.50 – 4.50
*BLACKSTONE (APARTMENT HOTEL), Charles & 33rd Sts.	2.50	4.00
*BRADFORD (APARTMENT HOTEL), 3301 St. Paul St.	3.00	4.00
*CHARLES (APARTMENT HOTEL), 3333 N. Charles St.	3.00	4.00
*COLONNADE, 1337 W. Mt. Royal Ave.	1.00 – 2.00	2.00 – 2.50
CONGRESS, 306 W. Franklin St.	2.50 – 3.00	4.00 – 5.00
EMERSON, Calvert & Baltimore Sts.	3.00 – 6.00	4.50 – 8.00
*FRANKLIN, 410 W. Franklin St.	1.00 – 2.00	2.00 – 2.50
*ALCAZAR (KNIGHTS OF COLUMBUS), Cathedral & Madison Sts.	1.00 – 2.50	3.00 – 5.00
*LATROBE (APARTMENT HOTEL), Charles & Read Sts.	2.50 – 3.00	5.00 – 6.00
*LONGFELLOW, 2 West Madison St.	2.00 – 3.00	3.00 – 6.00
LORD BALTIMORE, Baltimore & Hanover Sts.	3.00 – 6.00	5.00 – 8.00
*MADISON (APARTMENT HOTEL), 817 St. Paul St.	3.00	4.00 – 5.00
*MALLONEE, 111 W. Mulberry St.	1.00 – 1.50	2.50 – 3.00
*MARYLAND, 20 E. Fayette St.	2.00 – 2.50	3.00 – 4.00
*MILNER, Cathedral & Read Sts.	1.00 – 1.50	1.50 – 2.00
*MT. ROYAL, Mt. Royal Ave. & Calvert St.	2.50 – 3.00	3.50 – 5.00
NEW HOWARD, 8 N. Howard St.	2.50 – 3.00	3.50 – 5.00
*ONE HUNDRED AND ONE WEST MONUMENT ST. (APT. HOTEL)	3.00	4.00
*PLAZA, Charles St. & Mt. Royal Ave.	1.00 – 2.00	2.00 – 2.50
*REID, 212 W. Camden St.	1.00 – 1.50	1.50 – 2.00
RENNERT, Liberty & Saratoga Sts.	2.50 – 4.00	3.50 – 7.00
*SHERWOOD, 212 W. Monument St.	1.25 – 1.50	2.00 – 2.50
*SHIRLEY, 205 W. Madison St.	1.50	2.00
SOUTHERN, Light and Redwood Sts.	3.00 – 5.00	5.00 – 6.50
STAFFORD, Charles & Madison Sts.	3.00 – 4.00	5.50 – 7.00
*TEN HUNDRED AND ONE ST. PAUL ST. (APT. HOTEL)	3.00	4.00 – 6.00
*WALDORF, 1829 N. Charles St.	1.00 – 2.50	2.50 – 3.00
*WESTMINSTER, 418 W. Fayette St.	1.00 – 1.50	2.00 – 2.50
*Y. M. C. A., Cathedral & Franklin Sts.	1.00 – 1.25	1.50 – 2.00

Rates quoted are with and without bath.
*Hotels with less than 100 rooms.
The Centennial Committee on Hotels advises making reservations early.

BUREAU OF PUBLIC RELATIONS

AMERICAN DENTAL ASSOCIATION

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Chicago, Illinois

DENTAL HEALTH EDUCATIONAL MATERIAL

Dentists will find some of this material excellent for their waiting room table, and for use at the chair in educating both parents and children. *Education is the basis of preventive dentistry.*

Hygienists, nurses, teachers and public health workers will also find that much of this material will assist them greatly in their health activities. *Education is fundamental in public health work.*

Make use of this dental health educational material—order by number—A complete sample set of all material listed, $5.00

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5a. Disease Conditions of the Mouth and Their Relation to Health 5c
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7b. Your Teeth and Your Baby's Teeth (a prenatal booklet) 5c
(25 copies for $1.00)
7c. Outline of Lectures for Public Health Nurses and Teachers 5c
9. The Care of Children's Teeth (For adult audience) 5c
10. A Constructive Program for Dental Health 5c
12a. Two hundred and fifty radio talks.
5, 10, and 15 minute broadcasts in lecture and dialog form. Write for complete list.

PLAYS

19. The King's Soldiers (story) 5c
20. Stepping Stones to Happiness (dental playlet) 5c
20a. Bad Baby Molar (dental playlet) 5c
22. Sells Health-O Circus (dental playlet) 5c
22a. The Magic Basket (dental playlet) 5c
22b. The Dream Court (dental playlet) 5c
22c. A Toothbrush Fantasy (dental playlet) 5c
22d. Where's My Toothbrush? (dental playlet) 5c

MISCELLANEOUS

23a. Dental Health Education in Malden, Mass. Turner, Marshall and Ross 5c
26a. A Simplified Bookkeeping System for the Dentist 5c
27a. "What It Means to Be a Dentist," by L. E. Blauch, Ph.D. 5c
27b. "Dentistry as a Career," by L. E. Blauch, Ph.D. 10c
29a. Mouth Health of School Children. Report of the Joint Committee on Health Problems in Education of the N.E.A. and the A.M.A., with the Cooperation of the A.D.A., and the A.S.P.D.C. 25c

30a. "A Practical Dental Health Educational Program." 5c
30b. "Education of the School Child for Dental Health," by J. M. Wisan, D.D.S. 5c
31a. "Answer Your Own Dental Questions." A revolving colored disk which answers 24 common dental questions. Prices in quantity lots given on request 5c
32a. Pyraglazed 8½ x 15 McCall chart—Enlargements of Decay in First Permanent Molar... 35c
33a. "Public Health Aspects of Vincent's Infection," by J. M. Wisan 5c
36. "The Preparation and Delivery of a Speech," by Bertram G. Nelson 5c
36a. Instructions for speakers ("Fundamentals and Adjuncts in Dental Health Education," by Evelyn C. Schmidt) 5c
40a. List of Hospitals Offering Dental Internships 5c
40b. Pyraglazed (colored) 9 x 16 inch Bodecker Dental Decay Chart 30c
40c. Rhobotham Children's Dental Examination and Record Cards ..... 75c per 100
40d. "The Mouth Is a Gateway of Infection." 5 x 7 inch chart showing how good mouth hygiene reduces the danger from disease ..... Sample copy 1c; 50c per 100 copies
40e. National Dental Inspection Chart for School Children ..... 75c per 100
41. "John, Mary & Jack," 52 short semicontinued newspaper stories ..... No charge
41a. Diversified newspaper articles, each 350 words in length ..... Per set $2.50
42. Patient recall cards. Per hundred 50c
43. Patient recall card envelopes. Per hundred 50c
44a. Appreciation cards for referred patients ..... 100 cards and envelopes $1.50

A BENEFICIAL PRODUCTION CIRCLE

45. A PRACTICAL TOOTHBRUSHING CHART

A 21 by 27 inch chart. Printed on heavy paper and securely tinned at top and bottom ..... Single copies, 25c. In lots of 25 or more, 20c.

PRACTICAL TOOTH BRUSHING AND HABIT FORMING CHART
There are five surfaces of every tooth to brush: the grinding or chewing surface, the outside or cheek surface, the inside or tongue surface and the two surfaces in between. A toothbrush will not clean where it does not touch. Clean the teeth at least twice a day. Use a good, small toothbrush and a good dental cream or powder. Help build strong teeth by eating the right food, such as milk and other dairy products, vegetables, fruit, whole grain bread and cereals, meat and eggs; also eat some coarse food to exercise the teeth and gums. Play outside each day; sleep at least ten hours each night; visit your dentist at least every 4 to 6 months.

46. MOTION PICTURE FILM SERVICE

Dental educational films are available in both 35 m.m. and 16 m.m. stock. These may be rented for $1.00 a day or $3.00 a week, plus shipping charges both ways. Charge is made for each day of use before an audience, but no charge for time in transit. The renter is held responsible for injury to films. *In requesting films, please state the ones desired, when desired and for how long.* Following is a description of the films available:

"Your Mouth" (35 m.m.), 15 minutes. Synopsis: Gives cause, progress and results of tooth decay; methods of prevention; brings in nutritional aspect, use of roentgen rays, brushing, etc. Suitable for high school and adult audience.

"Tommy's Troubles" (16 m.m.), 20 minutes. Synopsis: On oral hygiene. Emphasizes importance of diet as well as cleanliness in care of teeth; shows proper method of brushing them.

"Bobby's Bad Molar" (35 m.m. and 16 m.m.), 15 minutes. Synopsis: Bobby has neglected his teeth and is paying the penalty by doing poor work in school, being backward in athletics, etc. One day his teacher sends him to the school dental hygienist, who examines his teeth. The hygienist explains Bobby's tooth troubles to him and urges him to go to the dentist at once and receive attention. Bobby takes her advice and finally becomes an enthusiastic advocate of the proper care of teeth.

"Life of a Healthy Child" (16 m.m.), 15 minutes. Both silent and sound. Synopsis: Illustrates activities of a normal child. Habits of cleanliness, correct diet, play, visits to dentist and physician are emphasized. For parent-teacher groups or child audiences.

"Ask Your Dentist" (35 m.m. and 16 m.m.). Excellent for high school and adult groups. Stresses the importance of diet, cleanliness and dental attention. A touch of humor is added by the use of cartoons.

"How Teeth Grow" (16 m.m.), 15 minutes. Synopsis: Eastman classroom film for health education. Shows in interesting and instructive manner growth and development of temporary and permanent teeth. Demonstrated through use of animation, models and subjects of various ages. (For children and adults.)

"Care of the Teeth" (16 m.m.), 15 minutes. Synopsis: Eastman classroom film for health education. Shows various phases of care of teeth such as diet, care by dentist, brushing and home care. Useful in giving fresh support to activities of dental hygiene program. Designed for individuals above fourth grade.

"Nature—Builder of Teeth" (16 m.m.); 1 reel. Shows the development of teeth from birth to adulthood. Explains the part played in facial development by the erupting forces of teeth; also effect of nutritional disturbances and illness on tooth development; mottled teeth, normal and abnormal occlusion. Written lecture accompanies film. Can be purchased for $25, or rented for usual rental fee.

"Betty's Crooked Teeth" (16 m.m.), 15 minutes. Synopsis: Betty is taken to the dentist for orthodontic treatment. While there the orthodontist explains with models, x-ray films and drawings the causes, prevention and correction of crooked teeth. Subsequent scenes show Betty after her teeth have been straightened and her improvement in health, looks and scholastic standing. For upper grade children and adults.

"The Road to Health and Happiness" (16 m.m.), 15 minutes. Both silent and sound. General child health film with special emphasis on dental health. Stresses diet, rest, exercise, school examination, immunization and dental hygiene. For both children and adults.

Technical Film: *"The Physiology of Mastication"* (16 m.m.); 2 reels. Synopsis: Study of jaw movements of various animals exhibiting types of mastication as an introduction to study of human beings. Animated skulls and cartoons are synchronized with mandibular movements of animals. The film shows that "three point contact" and "bilateral balanced occlusion" never occur in lower animals during process of incising and chewing tough resistant foods.

Technical Film: *"Mechanics of Balance in Dental Prosthesis"* (16 m.m.); 1 reel. Synopsis: Depicts clinical application of unilateral balance to prosthetic dentistry. Film is a continuation of the above-mentioned film, *"The Physiology of Mastication."*

Technical Film: *"Uses of Gelatin in Dental Arts"* (16 m.m.); 2 reels.

"The Life of Your Artificial Denture" (16 mm.). Shows how gum resorption alters the relationship of jaws and dentures, causing loss of masticatory efficiency, defective hearing, tongue interference, inability to open the mouth properly, loss of muscle tone and facial changes.

"Facial Changes" (16 m.m.). Models and photographs show the result of wearing dentures too long without refitting. Frequent replacement of dentures prevents uncontrollable resorption of gums and ridges which cause facial changes.

"Partial Dentures and Bridges" (16 m.m.). Models demonstrate how teeth shift after the loss of a tooth and pyorrhea and further tooth loss follow. Different types of bridges and partial dentures are shown and how their use can prevent serious dental destruction is demonstrated.

"How to Use Artificial Dentures" (16 m.m.). Demonstrates how to masticate with artificial dentures. Shows the importance of proper vertical relation to denture stability and appearance.

47. LANTERN SLIDE SERVICE

Lantern Slide Lectures:

"The Tooth Question," lecture (for adult audiences); 42 slides. (Requires one hour to present.)

"The Mouth and Its Message," lecture (for adult audiences); 13 slides. (Requires thirty minutes to present.)

"Prevention of Dental Decay" (for adult audiences); 33 slides. (Requires about forty minutes to present.) Covers tooth development, anatomy, diet, cleanliness, dental attention, progress and results of decay, pyorrhea and Vincent's infection.

"The Care of Children's Teeth" (for adult audiences); 48 slides. (One hour lecture.) Dental anatomy, eruption, diet, cleanliness and dental attention.

"Nature, Builder of Teeth," lecture (for adult audiences); 17 slides. (Requires about thirty minutes to present.)

"The Talking Tooth," lecture (for adult audiences); 2 slides (with six illustrations per slide). Requires about fifteen minutes to present.

"Pyorrhea," lecture (for adult audiences); 2 slides (with six illustrations per slide). Requires about one hour to present.)

"Syphilis: The Dentist's Part in the Program of Control" (for adult audiences); 18 slides. (Requires from 30 minutes to 1 hour.)

"Dental Health for the High School Student"; 30 slides. (Requires 40 minutes to present.) Tooth development, diet, cleanliness—regular dental attention. Results of dental neglect.

"The Teeth and Their Care," lecture (for school children of fifth to eighth grades); 12 slides. (Requires about thirty minutes to present.)

"Your Teeth," lecture (for school children of fifth to eighth grades); 40 slides. (Requires about one hour to present.)

"Your Teeth and Your Mouth" (5th to 8th grade children). 44 colored slides and film strip. (45 minutes to present.)

"Every Child's Treasure," lecture (for school children of first six grades); 31 slides. (Requires thirty minutes to present.)

"Johnny Don't Care's Teeth" (for fourth to eighth grade children); 22 colored slides. Self-explanatory; no written lecture necessary.

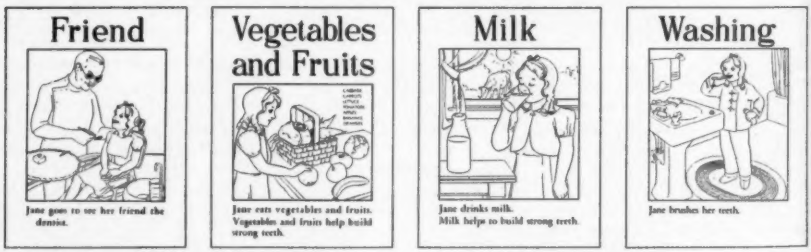
Lantern Slide Rental Service:

The Bureau has a large collection of slides (standard size, 3¼ by 4 inches) suitable for professional and lay groups. A complete list of these slides will be furnished on request. Any selection of slides may be rented on the basis of $1.00 a day or $3.00 a week, plus shipping charges both ways. No charge is made for time in transit or time spent in review. In requesting slides (provided you do not order from our list), please state the topics that you desire to cover, type of audience, number of slides, when wanted and length of time desired. The renter is held responsible for all breakage.

Lantern Slide Sales Service:

The Bureau will sell duplicates of any stock slides at the following prices: plain slides, 35c each; colored slides, 75c each. On request, the Bureau will prepare slides from photographs or cuts on the following basis: plain slides: negative, 25c; slide, 35c; making total cost for each original slide 60c; colored slides: negative, 25c; slides, 75c; making total cost for each original slide, $1.00. Remittance must accompany all orders.

47A. PRIMER DENTAL HEALTH EDUCATIONAL LEAFLETS


Friend
Jane goes to see her friend the dentist.
Vegetables and Fruits
Jane eats vegetables and fruits. Vegetables and fruits help build strong teeth.
Milk
Jane drinks milk. Milk helps to build strong teeth.
Washing
Jane brushes her teeth.

Eight leaflets designed for the primer grades (4 of which are shown). The other four cover: Breakfast, Lunch, Dinner and Sleep. Printed on 8 x 10½ inch drawing paper they are designed as seat work for the very young children.

One set of 8 leaflets—5 cents. Twenty-five sets of leaflets—75 cents.

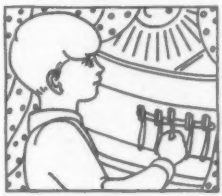
A BENEFICIAL PRODUCTION CIRCLE

48. SECOND GRADE DENTAL EDUCATIONAL LEAFLETS

GO TO THE DENTIST AT LEAST TWICE A YEAR

The dentist is my friend.
He helps me to have nice teeth.
I go to see him often.
Sometimes teeth have little holes in them.
If there are little holes in my teeth
the dentist will fill them.
He will help me to keep my teeth clean.

BRUSH YOUR TEETH TWICE A DAY



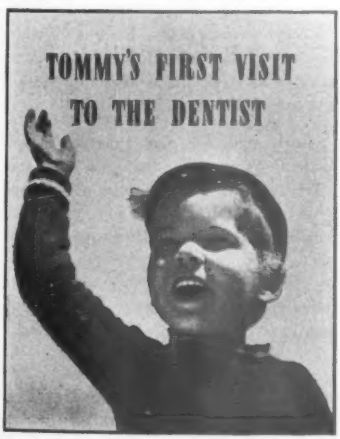
Here are our tooth brushes.
They are hanging in the sun.
The brushes are all small.
They have pretty colored handles.
The one with the yellow handle belongs to my mother.
The one with the green handle belongs to my father.
The one with the blue handle belongs to my sister.
The one with the red handle belongs to me.
I brush my teeth every night.
I brush my teeth very morning.

TOOTH BUILDING FOODS

Milk helps to build strong teeth.
Dark bread helps to build strong teeth.
Dark cooked cereals are good foods to build teeth.
I eat cereal and milk for my breakfast.
I sometimes have toast for my breakfast.
My teeth need milk and cereals.

Six leaflets designed for first or second grade dental education (three of which are shown). Each lesson is printed on 8 x 11 inch drawing paper. The wording is fitted to the first grade vocabulary. The text is scientifically correct. The drawings are simple and artistic. After each lesson is learned, the drawings are to be colored by the child. They enable educators to coordinate the teaching of dental health with that of art and of reading.

One set of six leaflets, 5 cents. Twenty-five sets of leaflets, 50 cents.

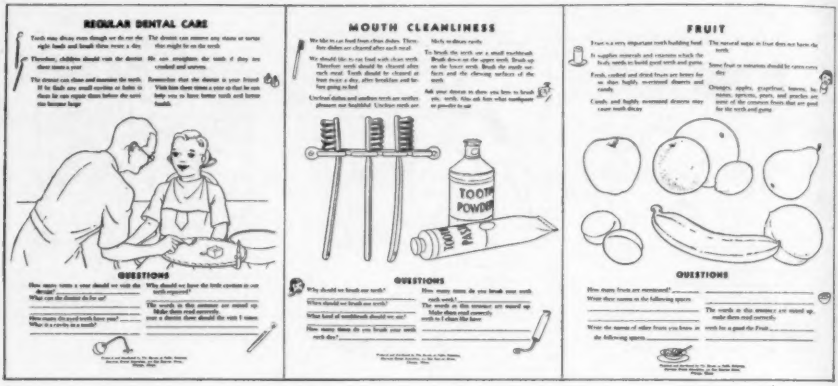


48-B. TOMMY'S FIRST VISIT TO THE DENTIST

A story of a real boy's visit to a real dentist, told with pictures to help other preschool children understand what to expect on their first visit to the dentist.

Single copies 5c.....25 copies $1.00

48-C. THIRD GRADE DENTAL EDUCATIONAL LEAFLETS



Six 8 x 11 inch leaflets designed for third or fourth grade children. The lessons are to be studied and the questions answered by the children. The drawings can then be colored. On the reverse side of each leaflet is an additional lesson.

One set of six leaflets 5c; 25 sets of leaflets 50c.

49. FOURTH GRADE DENTAL EDUCATIONAL BOOKLET

Jack and Joan are twins. They were twelve years old their last birthday. They have never had a single day of sickness. People who know them say they are the peppiest and liveliest children in town. They are never idle a minute. In the summer, they love to swim, ride and play tennis. In the winter, they enjoy skating, coasting and skiing. They are as happy and healthy as twelve year old children can possibly be. Both the winter and summer months are crowded with happy days for Jack and Joan. There are several reasons for these happy days which they learned from Uncle Dan. One of these reasons is told and pictured on the inside pages of this book. Color the pictures with crayon or water colors as you read the story of Happy Days.

DENTAL HEALTH EDUCATIONAL MATERIAL FOR FOURTH AND FIFTH GRADE CHILDREN

Happy Days with Jack and Joan is an eight page booklet on the care of the teeth which has been especially designed for children between the ages of nine and eleven.

The names, structure and function of the teeth, as well as the fundamentals of dental health, are explained in an interesting, yet simple manner. The text is scientifically correct. The illustrations are modern and artistic. After each lesson is learned, the illustrations can be colored by the child. This booklet will enable educators to coordinate the teaching of dental health with that of art and of reading.

Approved by educators, the American Dental Association and the United States Public Health Service.

Single booklet, 5c; sets of 35 booklets, 2c each.

50. EXHIBIT MATERIAL

A SMALL RENTAL CHARGE IS MADE FOR ALL EXHIBITS PLUS EXPRESS CHARGES TO AND FROM CHICAGO.

A-1: Three 12-inch latex models showing the value of x-rays in discovering interproximal and other hidden decay.

A-2: Five 12-inch latex teeth showing the progress of pyorrhea.

Both A-1 and A-2 shipped in one case. Rental per week, $3.

A-3: Two 12-inch latex models showing the value of the x-rays in discovering the presence of root fragments.

A-4: Two 12-inch latex models showing the value of x-rays in discovering the presence of impacted teeth.

Both A-3 and A-4 shipped in one case. Rental per week, $3.

A-5: Four 12-inch latex models showing the changes that often occur after the extraction of a tooth. Rental per week, $3.

"A" Models are illustrated on page 1873, November 1938 Journal of the A.D.A.

B-1: Electrically motivated mechanical exhibit showing the progress of decay from its initial attack on enamel to the formation of an abscess; 3 feet high by 2½ feet wide, standing on a 3-foot base; all-over height, 6 feet. Rental per week, $5.

B-2. Electrically motivated mechanical exhibit showing gum and bone destruction caused by calculus deposits: 3 feet high by 2½ feet wide, standing on a 3-foot base; over-all height, 6 feet. Rental per week, $5.00.

C. Latex models.

C-1—12 inch longitudinal section of lower molar.....Rent per wk. $1.00

C-2—12 inch section of jaws showing structures of the mouth.....Rent per wk. $1.00

C-3-a—Face mask of closed bite caused by loss of 1st molar.

C-3-b—Same case after correction—Set of two.....Rent per wk. $1.00

C-4-a—Face mask of edentulous patient before.

C-4-b—Face mask of edentulous patient after.
Set of two.....Rent per wk. $1.00

C-5-a Oversize adult head showing normal occlusion.

C-5-b Oversize adult head showing loss of 1st permanent molar.
Set of two.....Rent per wk. $1.00

C-6-a Oversize child head—normal occlusion.

C-6-b Oversize child head—thumb sucking.

C-6-c Oversize child head—results of thumb sucking.
Set of three.....Rent per wk. $1.50

C-7 Oversize child head—dentition of 6 year old child.....Rent per wk. $1.00

"C" Models are illustrated in December 1938 Journal of the A.D.A.

E-4. Two illuminated pictures, 18 inches square; a boy with a good profile, which when illuminated from behind shows an even set of teeth; and a boy with a poor profile, which when illuminated from behind shows irregular, broken down teeth. Illuminated by means of flash buttons. Wt. approximately 35 to 40 lbs. Rental per week.....$2.00

E-8-a. A series of four 12 in. latex plaques for wall or window display showing progress of decay. Wt. approximately 25 lbs. Rental per week.....$2.00

E-8-b. A series of four 12 in. latex plaques for wall or window display showing progress of pyorrhea. Wt. approximately 25 lbs. Rental per week.....$2.00

E-9. "Answer Your Own Dental Questions." An exhibit 6 feet wide by 8 feet high. By means of a revolving disk you can answer your own dental questions. Shipped in 2 fiber cases, total wt. 190 lbs. Rental per week.....$2.00

E-10. Teeth and Personal Appearance, illustrated on page 1573, September 1939 Journal A.D.A. Six ft. high by 12 ft. long. Side panels contain photographs showing effect of good and bad teeth upon appearance. Center panel contains an electrically motivated exhibit showing effect of bad teeth upon appearance. Wt. approximately 525 lbs. Rental per week.....$10.00

50a. MODELS AND MOLDS FOR OFFICE AND SCHOOLS

D-1 and D-2. 4½ inch latex models showing progress of decay in molar. Illustrated page 1013 June 1939 Journal. Excellent for schools and private office.....$1.50

D-3 and D-4. Natural size latex models of lower set of deciduous teeth. Illustrated page 1013 June 1939 Journal. Excellent for schools and private office.....$1.50

The two sets complete (D-1, 2, 3, 4) sell for $2.50.

R.G. Hand painted plaster models 2⅜ x 1⅞ x ⅝ inches. See illustrations on pages 1571-1572 September 1939 Journal.

R.G-1. Longitudinal section of central incisor.....$1.25

R.G.2. Longitudinal section of lower bicuspid.....$1.25

R.G.3. Longitudinal section of lower molar.....$1.25

R.G.-4. Longitudinal section of upper first bicuspid.....$1.25

R.G.-5. Bicuspid and molar showing interproximal decay.....$1.25

R.G.-6. Impacted lower third molar.....$1.25

R.G.-7. Normal occlusion $1.25

R.G.-8. Malocclusion following loss of molar.....$1.25

Rubber molds of each of the R.G. models with which the dentist can make his own models. 75c

Model Display Case. Black imitation leather. Transparent cover. Holds four models. (See page 1910 November 1939 Journal).....$2.00

Any four models plus display case.....$6.50

51. BOOKLET ON CARE OF THE TEETH

Attractive 32 Page Booklet

Written in lay language, illustrated with eighty photographs of actual cases and models. Each illustration tells its own story. Approved by the American Dental Association and the United States Public Health Service.

Prices—10c per single copy; 12 copies—$1.00; 50 copies—$4.00; 100 copies—$7.50; 500 copies—$25.00; 1,000 copies—$45.00.

A BENEFICIAL PRODUCTION CIRCLE

52. DENTAL HEALTH POSTERS

Twice a year we come to town
Just to visit Dr. Brown
Dr. Brown our teeth inspects
And keeps them free from all defects.

Four 22 x 28 inch posters, in color (only one of which is shown), emphasizing four dental health rules for the care of the teeth: proper food, exercise, cleanliness and regular dental attention.

Approved by the American Dental Association and the United States Public Health Service.

1 Set—$1.00
10 Sets—90c per set.
25 Sets—85c per set.
50 Sets—75c per set.
100 Sets—60c per set.

A BENEFICIAL PRODUCTION CIRCLE

53. DENTAL HEALTH CHARTS

Eight large charts, designed for high school and adult teaching.

Subjects covered: The teeth; the deciduous teeth; the permanent teeth; diet and teeth; dental care; mouth hygiene; preventing decay of the deciduous teeth; preventing decay of the permanent teeth.

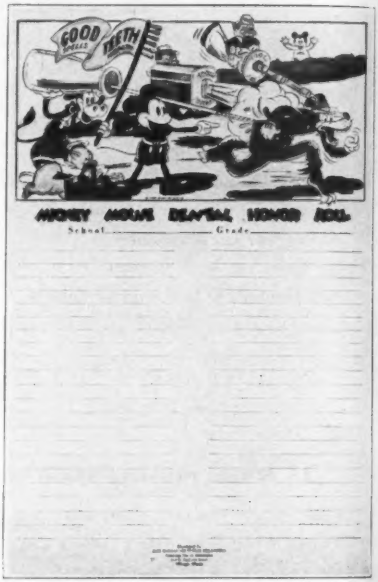
Beautifully illustrated in five colors and bound with modern spiral binding into one complete dental health educational unit. 22x29 inches in size, each chart consists of one 14 inch illustration accompanied by suitable descriptive text.

1 Set—$1.00
10 Sets—90c per set
25 Sets—85c per set
50 Sets—75c per set
100 Sets—60c per set

54. MICKEY MOUSE MATERIAL

Let Mickey Mouse Help You Prevent Decay.

"Clean teeth" Certificate—to be given children who have kept their teeth clean for a specified length of time.



Dental Honor Roll—on which is to be entered the names of all children who are free from dental defects.

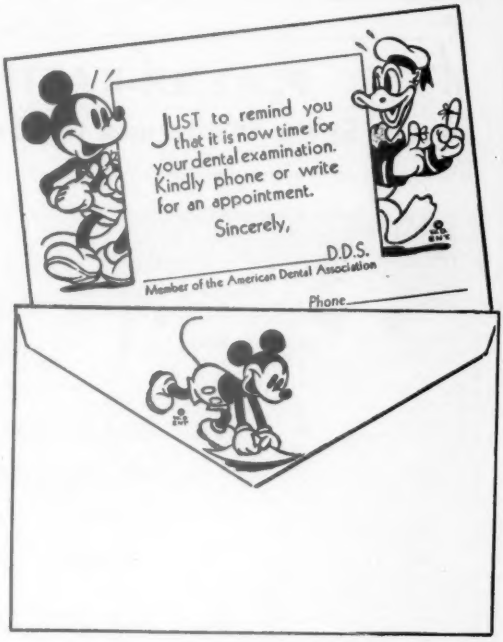
"Good teeth" button—to be given children who have had all dental defects corrected.

54. Mickey Mouse Dental Health Unit.....$1.00
(Consists of 40 "clean teeth" certificates, 20 good teeth buttons and one dental honor roll.)
54a. Certificates in lots up to 500, 1c each; 500 for $4.75; 1,000 for.....$9.00
54b. Buttons, 20 for 75c. In lots of 100 or more.....2½c each
54c. Honor Rolls. 10c each. 100 for $5.00. 500 for $20.00. 1,000 for.....$35.00

55. CHILDREN'S DENTAL RECALL CARDS

Let Mickey help you remind your child patients that it is time for a reexamination.

50 cards and envelopes $1.50.
100 cards and envelopes $2.00.


JUST to remind you that it is now time for your dental examination. Kindly phone or write for an appointment.
Sincerely,
D.D.S.
Member of the American Dental Association
Phone

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56. BLOTTERS

These six blotters illustrated, in 2 colors, are reproductions of winning designs submitted in the NATIONAL POSTER CONTEST

Can be mailed monthly to patients — or given to children for school use.

Sample Set of 6, 10c
25 Sets (150 blotters).....$2.50
50 Sets (300 blotters).....$4.50
100 Sets (600 blotters).....$7.50

57.

PLASTER-KASTER SETS
Snow White and the Seven Dwarfs

RUBBER
MOLDS
OF
SNOW WHITE AND THE
SEVEN DWARFS

5¾" in height

3¾" in height

MOLD THEM YOURSELF
AND GIVE THEM TO
YOUR CHILD PATIENTS

3¾" in height

Snow White is 5¾ inches in height; the Dwarfs are 3¾ inches in height.
SNOW WHITE 75c—DWARFS 50c each—MOLD STAND 25c

THE BUREAU OF PUBLIC RELATIONS
American Dental Association,
212 E. Superior St., Chicago, Ill.

Enclosed is $_____ for Rubber Molds of:

☐ Doc.
☐ Dopey.
☐ Bashful
☐ Happy
☐ Grumpy
☐ Sneezy
☐ Sleepy

A BENEFICIAL PRODUCTION CIRCLE

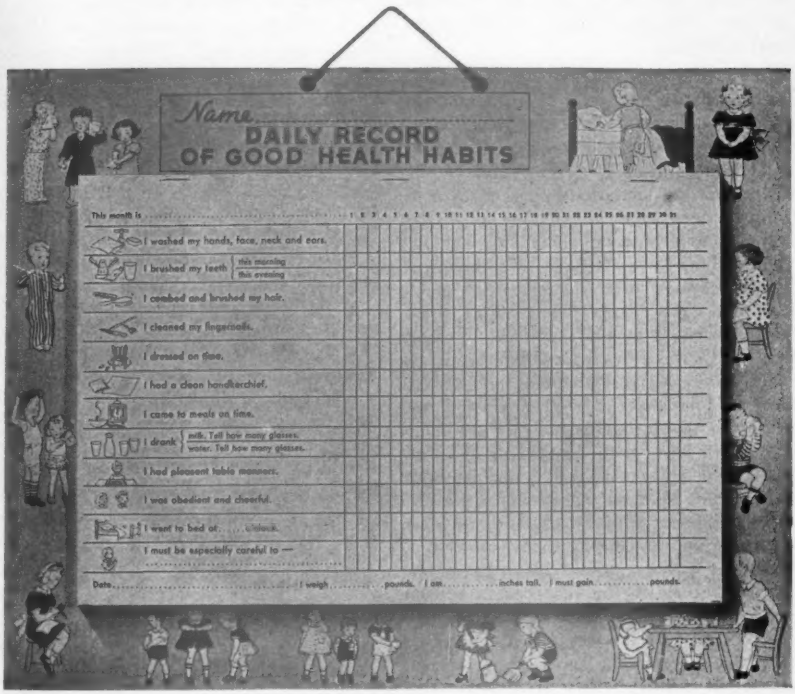
Enclosed is: ☐ 25c for Mold Stand.
Enclosed is: ☐ 75c for Rubber Mold of Snow White.

Name_____

Street_____ City_____ State_____

Please print plainly full name and complete address

58. DAILY RECORD OF GOOD HEALTH HABITS


Name
DAILY RECORD
OF GOOD HEALTH HABITS
This month is
I washed my hands, face, neck and ears.
I brushed my teeth this morning this evening
I combed and brushed my hair.
I cleaned my fingernails.
I dressed on time.
I had a clean handkerchief.
I came to meals on time.
I drank milk. Tell how many glasses. water. Tell how many glasses.
I had pleasant table manners.
I was obedient and cheerful.
I went to bed at o'clock.
I must be especially careful to —
Date I weigh pounds. I am inches tall. I must gain pounds.

It's wrapped in sparkling cellophane! Size 14 x 11 inches. There are twelve monthly record sheets firmly wire-stitched to a sturdy cardboard base, printed in five colors. On the reverse side are Weight—Height—Age tables and helpful suggestions to parents for making the chart effective in building good health and behavior habits in their children.

Price 35c

CURRENT LITERATURE

Clinical and Experimental Observations on Focal Infection, with an Analysis of Two Hundred Cases of Rheumatoid Arthritis

By R. L. Cecil and D. M. Angevine

In this paper, the term "rheumatoid arthritis" is used to describe the picture of a chronic progressive inflammatory disease of several joints, which is characterized in the early stages by periarticular swelling and fusiform fingers, and in the later stages by ankylosis and deformity.

The authors review a series of 200 clinical cases of "chronic infectious arthritis," which Cecil and Archer reported in 1927, with special reference to the incidence of focal infection. In this report, focal infections appear to have been very common, and the removal of foci, especially when carried out early in the disease, seemed to produce beneficial results in a good proportion of cases. Today, the authors would probably omit many of the cases as not fulfilling the criteria of rheumatoid arthritis, and, in view of present knowledge, it is possible that a good many patients would have shown improvement even if the foci had not been removed.

In contrast with this series, they present an analysis of a group of 200 cases of typical rheumatoid arthritis, taken from records in the private practice of Cecil. No case has been included that did not fulfill the classical pattern of the disease. For example, every case in the series showed, or had shown at some time previously, several characteristic fusiform fingers which, in the authors' opinion, are a typical manifestation of this syndrome. The sedimentation rate was accelerated in 93 per cent of the patients, and the agglutination reaction with a strain of hemolytic streptococcus was strongly positive in 65 per cent. There was definite evidence of infection in 20 per cent and a questionable focus in 10 per cent. Seventy per cent of the patients revealed no demonstrable focus of infection.

Experimental work was performed on rabbits in an attempt to produce foci of infection and arthritis. From these studies, the following information was obtained:

1. Arthritis was produced in only eleven of 100 rabbits which were given injections by other than the intravenous route. To accomplish this it was necessary to use large doses of a suitable strain of streptococcus, as well as a most susceptible animal.

2. Arthritis developed only in those animals in which streptococci were recovered from the blood stream shortly after the injection.

3. In rabbits the gums were a particularly favorable site for the absorption of bacteria.

4. Repeated injections of bacteria caused no more arthritis than a single injection.

5. It was difficult to establish a chronic, persistent focus of infection in rabbits.

The authors stress the point that, in the final analysis, the decision regarding the eradication of so-called foci of infection should be made by the internist rather than by the specialist, and that physicians should exercise a more conservative attitude than they have in the past regarding the treatment of tonsils, teeth, and sinuses in rheumatoid arthritis.

A complete revaluation of the focal infection theory is necessary. Undoubtedly, there are cases of infectious arthritis which result from focal infection. However, as far as typical rheumatoid arthritis is concerned, it would appear from this study that chronic focal infection plays a comparatively unimportant rôle.—*Ann. Int. Med.*, **12**:577, November 1938; abstr. *Surg. Gynec. & Obst.*, **69**:104, July 1939.

Die Akute Myeloische Leukämie und Ihre Ersten Manifestationen in der Mundhöle (Acute Myeloid Leukemia and the First Manifestations in the Oral Cavity)

By O. Kleiser

In this interesting and comprehensive article, the author discusses first, in general, diseases of the oral cavity. Oral manifestations of affections involving the blood-forming organs are stressed and acute myeloid

leukemia is discussed in an authoritative manner. The etiology, pathology, histology, diagnosis, methods of differential diagnosis, therapy and prognosis are each taken up in chronologic order. The normal human blood picture is reviewed and the pathologic variations encountered in the four cases of acute myeloid leukemia are cited by the author and described with accompanying photomicrographs of the cell elements. Illustrations of oral manifestations accompany the case histories.

The obligations and pitfalls of the dentist regarding proper diagnosis of this blood dyscrasia are stressed. The ease of confusion with other diseases is realized and the disasters consequent to an error in diagnosis, especially in cases of oral surgery, are recognized. The presence of hard cervical lymph nodes, mucous membranes showing pathologic change, necrotic gingivae and enlarged axillary or inguinal glands should be immediate grounds for suspicion. The blood picture in such cases should be accurately studied, as well as determination of the bleeding and coagulation time. No single symptom should be exaggerated in diagnosis. Rather, a summation plus the ability to have clearly in mind the various diseases which bear similar symptoms is important. Especially must we desist from tooth extraction where a slumbering leukemia may be aroused. Legal difficulties in such cases are very likely to ensue and the dentist will be unable to adequately describe the blood picture prior to operation. In this connection, the following points are briefly mentioned:

1. X-ray examination often discloses an infiltrating leukemia as ossifying or osteomyelitic processes of the jaw.

2. Likewise, accompanying tooth pain is not so much different from pulpitis or periodontitis symptoms, but it is not so likely to be confined to a single region in leukemia.

3. Tooth extraction at the onset of the blood dyscrasia is always contraindicated, as the rapid course of the leukemia could not support the healing process.

4. To differentiate between acute myeloid leukemia and trauma on the one hand and sepsis on the other is very difficult. Further complications are interposed when the common triad, leukemia, necrotic inflammation and sepsis, is present.

5. It is a striking fact that where there is acute myelogenous leukemia after tooth extraction, a field is offered for necrosis to proceed at a rapid pace; when, but for the surgical interference, the sepsis would not have been started.

6. No known therapy is of avail once this process has been set in motion.—*Deutsche Zahn-, Mund- u. Kieferheilk.*, **6**:511, August 1939.

VIRGIL D. CHEYNE.

Metabolism of Inorganic Phosphorus of Rat Bones and Teeth as Indicated by the Radioactive Isotope

By MARIAN L. MANLY & W. T. BALE

THE presence of phosphorus fed as disodium acid phosphate was studied by the authors in the bones and teeth of rats. A rapid deposition of blood phosphorus took place in the epiphyses of the bones. The incisors showed varying amounts in the different arbitrary divisions of the tooth, highest in the root, in which it was incorporated as the tooth grew. A small turnover was observed in the molars.—*J. Biol. Chem.*, **129**:125, July 1939.

VIRGIL D. CHEYNE.

Histology and Histopathology of the Dental Innervation

By R. BRADLAW

THE presence of a perivascular neural plexus in the periodontal membrane suggests that the dental structures have both a sensory and an autonomic nerve supply. The fibers described by Mummery are unaffected by section of the inferior dental nerve, although there is marked degeneration in all demonstrable nerves. Nerve fibers have been observed describing simple and complex looping in the odontogenic zone and others which, running tangentially between the odontoblast layer and the dentin, form a very definite nerve plexus. Attached to these nerve fibers are numerous round or pear-shaped bodies which may be either nerve cells or end-organs. Definite nerve fibers have been traced into the dentin.

No abnormality of innervation has been found in supernumerary teeth; teeth from cleft palates, dentigerous and ovarian cysts, and pulps of denticles from compound odontomes. Since there is no difference in the innervation of heterogenous and autogenous tooth germ transplants, whether of

normal or abnormal form, it would seem that abnormalities of form are not due to abnormal innervation. — *Proc. Roy. Soc. Med.*, 32:1040, July 1939.

B. P. KEARNEY.

Cultural Study of Filamentous Bacteria Obtained from the Human Mouth

By BASIL G. BIBBY and G. P. BERRY

BY the use of anaerobic methods and a wide variety of culture media, eighty-three strains of filamentous bacteria were isolated from *materia alba*, calculus and scrapings from teeth, gingivae and mucous surfaces in healthy and diseased mouths. On the basis of structure and colonial form, these filamentous, pleomorphic, non-spore-forming, non-motile organisms were divided into seven groups, six of which had distinct characteristics. Continued strains of group I showed uniform cultural and biochemical properties. The name *Leptotrichia buccalis* was proposed for this group. Four of the groups had characteristics of the genus Leptotrichia, one of those of the genus Fusiformis, and one those of both genera. Biochemical and cultural properties of the groups are given.—*J. Bact.*, 38:263-274, September 1939.

M. VAN KESTERN.

Long Term Experiment with Rats on a Human Dietary. II. Calcium and Phosphorus Depletion and Replacement

By W. E. GAUNT, J. T. IRVING AND W. THOMSON

A GROUP of rats was fed on a poor human dietary supplemented with milk and green food. A second group was fed the same basal diet with calcium and phosphorus added as salts in amounts equal to that present in milk and green food. The experiment was continued over three generations.

It was obvious that calcium and phosphorus were the chief deficiencies in the poor diet because the diet supplemented with calcium and phosphorus promoted reproduction, calcification and tooth formation as effectively as the diet supplemented with milk and green food. The former diet was, however, unable to maintain the growth rate over several generations so effectively as in the first generation. Under conditions of calcium and phosphorus lack, tooth formation was less adversely affected than skeletal ossification.—*J. Hyg.*, 39:91, March 1939.

M. VAN KESTERN.

Les Cils Chez Les Bacilles Appartenant au Groupe des Fusiformis

By W. KAZEEFF

Fusiformis dentium and *Fusiformis nucleatus* possess peritrichous cilia and consequently are mobile. Their cilia stain differently from the cilia of ordinary bacteria by the method of Tribondeau-Fontana. The microscopic appearance of these cilia indicates that their construction is different from that of ordinary bacteria. There are some indications that *Fusiformis nucleatus* is ciliated, but this is not definitely established. —*J. Bact.*, 38, July 1939.

M. VAN KESTERN.

Solid to Cystic Degeneration in Ameloblastoma

By H. B. G. ROBINSON and W. R. J. WALLACE

IN a case of multicystic ameloblastoma, five years previously a growth of this neoplasm had been removed and was found to be a solid tumor. The case strongly confirms previous records that ameloblastoma changes from a solid to a cystic stage through degeneration of stellate, reticular-like cells. —*Arch. Path.*, 28:207, August 1939.

ARTHUR F. FISHER.

Dental Lesions Observed After Roentgen Therapy in Cancer of the Buccal Cavity, Pharynx and Larynx

By J. A. DEL REGATO

DENTAL lesions are seen in the greater number of patients treated by roentgen rays for tumors of the tonsils, pharynx and larynx. The lesions are of more or less slow evolution and are notably (a) superficial caries of the tooth neck which progresses until the crown is completely amputated, (b) early wearing away of the incisal and occlusal surfaces and (c) gingivitis often accompanied by caries.

The lesions are not dependent on direct action of the rays, since they appear frequently in patients whose teeth or maxillae have not been irradiated.

The author advises that "in awaiting the time when one can avoid the production of these lesions by modifications of technique in roentgen therapy, a preliminary extraction of the greater number of teeth is a prudent procedure."—*Am. J. Roentgenol.*, 42: 404, September 1939.

B. P. KEARNEY.

Rare Tumor of the Tongue, Manifestation of Post Kala-Azar Dermal Leishmaniasis

By S. K. GHOSH DASTIDAR

DERMAL leishmaniasis is quite rare and especially so in the United States. Brochmachari, in 1922, reported a case with nodular skin lesions simulating leprosy as a sequel of kala-azar. Action and Napier, in 1927, described three distinct types: (1) an early depigmental stage, (2) a later nodular stage and (3) a xanthoma type.

Napier and Das Gupta, in 1930, in an extensive study of this condition, recognized several clinical types. In 1934, they reported cases in which the mucous membrane of the oral cavity was involved.

The author, during his four years of intensive study, has collected notes on eleven cases, including a new type with nodular swelling of the tongue as a rare manifestation. He gives a detailed report of this case. —*Brit. Med. J.*, 2:14, July 1, 1939.

J. FRANK HALL.

Origin and Excretion of Calcium into the Saliva After Stimulation of the Chorda Tympani

By L. KESZTYÜS and J. MARTIN

The calcium in the saliva after stimulation of the chorda tympani is the same as that of the blood serum. It, therefore, probably arises by simple filtration.—*Arch. f. d. ges Physiol.*, 241:241, 1938; *Chem. Abstr.*, 33: 4654.

VIRGIL D. CHEYNE.

Changes in the Composition of the Saliva and Blood Produced by Pilocarpine

By R. VLADESCU and G. NICHITA

IN dogs, the intravenous injection of 0.5 mg. per kilogram of pilocarpine-hydrochloride produced an increase in saliva chloride, a slight decrease in the blood chloride, a marked decrease in erythrocyte sedimentation velocity, a lowering of the cryoscopic point of the saliva and a general stimulation of glandular activity, as shown by an increased flow of urine, bile and gastric, duodenal and pancreatic juices. —*Compt. Rend. Soc. de Biol.*, 130:1154, 1939; *Chem. Abstr.*, 33:5504.

VIRGIL D. CHEYNE.

Normal Urinary Fluorine Excretion and the Fluorine Content of Food and Water

By W. MACHLE, E. SCOTT and J. TREON

WIDELY distributed random samples show that there is a usual fluorine excretion of approximately 1 mg. per liter of urine. In areas of the U.S.A. where the fluorine content of water is low (less than 0.1 mg. per liter), the fluorine content of local foodstuffs accounts for the greatest daily fluorine intake and excretion. In areas where the fluorine content is high, the proportion of fluorine contributed to the organism by the food is relatively unimportant.

The fluorine content of the urine of subjects living in an area where mottled enamel is endemic and the fluorine content of the drinking water is high greatly exceeds that found in localities not so affected, and, in the former, there is apparently a direct correlation between the amounts of fluorine in the drinking water and the concentration of fluorine in the urine.

Comparison of the fluorine content of foodstuffs obtained in areas where mottled enamel is not found and in areas where it is endemic indicates that food plays a small rôle in the production of mottled enamel.—*Am. J. Hyg.*, 29, No. 3, 1939.

MARY VAN KESTEREN.

Trois Cas de Coloration Brune de L'É de Toutes les Dents Chez Trois Enfants de Même Famille (Three Cases of Brown-Colored Enamel, Affecting All Teeth of Three Children of the Same Family)

By JOHAN RYGGE

THE author reports three cases of a peculiar brown colored enamel of all the teeth of a girl 18 years old and her two brothers aged 19 and 13 respectively, living in the southern part of Norway. The teeth of their parents were normal with respect to

the color of the enamel. In the children, however, both the deciduous and the permanent dentition were affected. The color spread over all tooth surfaces. The enamel of unerupted or newly erupted teeth was found to be more definitely yellowish red. In spite of a pronounced porosity of the enamel, all teeth showed a remarkable freedom from caries. Microscopic examination of the teeth revealed that the color diffused throughout the enamel. The striae of Retzius and the interprismatic lines and cross stripes were pronounced. In studying the cause of this discoloration, the remarkable finding was a copper content of 0.01 per cent in the enamel, whereas no copper could be detected in the dentin or cementum. The early history of the three young people showed that they had not been affected with any disease, not even the children's diseases. A complete medical examination of the girl gave no information bearing on the condition of the teeth. She and her brothers, as well as their parents, are all blond. They have blue eyes and no pigmentation of the skin. The author directs attention to the occurrence of stained enamel in certain animals. In the rodent teeth of the beaver, it was found that the enamel had a copper content corresponding to the amount found in the teeth of the girl.—*Acta Odontol. Scandinav.*, 1:57, June 1939.

R. F. Sognnaes.

Comparison of the Toxicity of Fluorine in the Form of Cryolite, Administered in Water and in Food. II.

By M. Lawrenz, H. Mitchell and W. Ruth

The same dosage of fluorine, in the form of cryolite, was given to each of twelve pairs of young albino rats. One of each pair received the cryolite in solid form, mixed with its food; the other, cryolite in aqueous solution. The method of administration of fluorine at low intake had no apparent effect on the rate of growth. Administration in water, however, definitely depressed the appetite of the rats and induced a transient hematuria. Whether fluorine was administered in water or in food did not make much difference in the time of appearance of striations in the lower incisors. Doses of fluorine in the food were retained to a less extent in bones, teeth and soft tissues than were equal doses in drinking water. Continued ingestion of low concentrations of fluorine in food or in water by growing animals caused a smaller percentage retention in the body. Considering the differences in toxicity of fluorine in water and in food, it is estimated for human diets that 1 part fluorine per million of drinking water (upper limit of safety) is the hygenic equivalent of 2.4-4.9 parts per million of fluorine in the total food.—*J. Nutrition*, 18:127, August 1939.

R. F. Sognnaes.

Perimylolysis (A Contribution on the Genesis of Tooth Wasting from Non-Mechanical Causes)

By J. J. Holst and Finn Lange

A type of erosion of the dental hard tissue called perimylolysis is described in three women and three men between 30 and 50 years of age. The characteristic feature of this wasting away of tooth substance was its localization on the lingual surfaces of the teeth, which were left smooth without cavity formation. All patients examined reported suffering from gastric dysfunction of long standing. Furthermore, the symptoms of this condition had been the same in all cases; namely, pyrosis and vomiting for some time and, in a single case, mainly regurgitation.

It is assumed that this particular form of dental erosion is partly due to the chemical action of gastric acid, and partly due to the mechanical influence of the tongue when moved against the teeth.—*Acta Odontol. Scandinav.*, 1:36, June 1939.

R. F. Sognnaes.

Biochemical Studies on Carbohydrates. XLV. "Sublingual Mucoid" and an Artificial Saliva Mucin

By Y. Tanabe

An acid soluble glycoprotein was isolated from the sublingual gland and called sublingual mucoid. This mucoid conjugated gelatin to form an artificial saliva mucin. It was concluded, therefore, that sublingual mucin is composed of sublingual mucoid and a protein which involves a glucosamine mannose complex.—*J. Biochem.*, 30:11, 1939.

Martin Deakins.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ASSOCIATION OF ORTHODONTISTS, Chicago, Ill., May 13-16, 1940.

AMERICAN DENTAL ASSOCIATION, Cleveland, Ohio, September 9-13, 1940.

CHICAGO DENTAL SOCIETY MIDWINTER MEETING, February 12-15, 1940.

DENTAL CENTENARY, Baltimore, Md., March 18-20, 1940.

DENTAL PROTECTIVE ASSOCIATION, Chicago, Ill., December 18.

DENVER (COLO.) DENTAL ASSOCIATION, Denver, January 7-10, 1940.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month from October to June at the United States Public Health Service Auditorium, Washington.

FIVE STATE POST GRADUATE CLINIC, Washington, D. C., May 19-23, 1940.

GREATER NEW YORK DENTAL MEETING, New York, N. Y., December 4-8.

GREATER PHILADELPHIA ANNUAL MEETING, January 30-February 2, 1940.

INTERNATIONAL COLLEGE OF DENTISTS U.S.A. SECTION, New York, N. Y., December 3-4.

NATIONAL BOARD OF DENTAL EXAMINERS, December 4-5.

STATE SOCIETIES

January

Rhode Island, at Providence (17-18)

February

Minnesota, at St. Paul (27-29)

April

Alabama, at Birmingham (9-11)
Kansas, at Kansas City, Mo. (28-May 1)
Louisiana, at Monroe (18-20)
Michigan, at Detroit (15-17)
Missouri, at Kansas City (28-May 1)
Texas, at Dallas (9-11)

May

Georgia, at Macon (14-16)
Indiana, at Indianapolis (20-22)
Montana, at Billings (2-4)
New Jersey, at Asbury Park (8-10)
New York, at Buffalo (14-17)
South Dakota, at Sioux Falls (12-14)
Tennessee, at Memphis (13-16)

June

Connecticut, at New London (5-7)
Maine, at Lakewood (23-25)

STATE BOARDS OF DENTAL EXAMINERS

California, in San Francisco, December 4. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Iowa, at Iowa City, December 11-15. Hardy F. Pool, Mason City, Secretary.

Minnesota, in Minneapolis, December 15-21. Paul Hagen, Crookston, Secretary.

New Jersey, December 11-6. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

Pennsylvania, in Philadelphia and Pittsburgh, December 5-9. Reuben E. V. Miller, 61 North Third St., Easton, Secretary.

Rhode Island, in Providence, December 12-14. Philip J. Conley, 2 Old Colony Bldg., West Warwick, Secretary.

Wisconsin, in Milwaukee, December 11-15. S. F. Donovan, Tomah, Secretary.

GEORGIA DENTAL ASSOCIATION

THE seventy-second annual meeting of the Georgia Dental Association will be held at Macon, May 14-16, with headquarters at the Hotel Dempsey.

R. H. MURPHY, *Secretary*,
920 Ga. Cas. Bldg.,
Macon.

MAINE DENTAL SOCIETY

THE seventy-fifth annual meeting of the

Maine Dental Society will be held June 23-25, at Lakewood (Skowhegan).

PHILIP W. WOODS, *Secretary,*
State Bureau of Health,
Augusta.

NEW JERSEY STATE DENTAL SOCIETY

THE annual meeting of the New Jersey State Dental Society will be held May 8-10, at the Berkeley-Carteret Hotel, Asbury Park.

F. K. HEASELTON, *Secretary,*
223 E. Hanover St.,
Trenton.

RHODE ISLAND STATE DENTAL SOCIETY

THE Rhode Island State Dental Society will hold its next annual meeting January 17-18 at the Biltmore Hotel, Providence.

EDWARD C. MORIN, *President,*
188 Main St.,
Pawtucket.

TENNESSEE STATE DENTAL ASSOCIATION

THE Tennessee State Dental Association will hold its seventy-third annual meeting May 13-16 at the Hotel Peabody, Memphis.

H. M. TAYLOR, *Secretary,*
206 Medical Arts Bldg.,
Knoxville.

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners will hold its next session for the examination of candidates in Parts I and II, December 4-5, in schools where there are five or more candidates. For information and applications, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven, Conn.

DENTAL CENTENARY CELEBRATION

THE one hundredth anniversary of the founding of professional dentistry will be celebrated in Baltimore, Md., March 18-20.

MEYER EGGNATZ, *Secretary,*
Medical Arts Bldg.,
Baltimore, Md.

DENTAL COUNCIL AND EXAMINING BOARD OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will conduct examinations in Philadelphia and Pittsburgh, December 5-9. For information and application blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg, or

REUBEN E. V. MILLER, *Secretary,*
61 North Third St.,
Easton.

FIVE STATE POST GRADUATE CLINIC

THE Eighth Annual Five State Post Graduate Clinic of the District of Columbia Dental Society will be held May 19-23, at the Willard Hotel, Washington.

DAVID J. FITZGIBBON, *Chairman,*
Publicity Committee,
1801 Eye St.,
Washington.

GREATER NEW YORK DENTAL MEETING

THE Fifteenth Annual New York Dental Meeting will be held December 4-8 at the Hotel Pennsylvania, New York City.

PERCY T. PHILLIPS, *Chairman,*
Press and Publicity.

DENVER DENTAL ASSOCIATION

THE Denver Dental Association will hold its thirty-third annual Rocky Mountain Midwinter Meeting, January 7-10, at the Shirley Savoy Hotel, Denver, Colo.

ALBERT P. HORTON, *Director,*
206 Metropolitan Bldg.,
Denver.

INTERNATIONAL COLLEGE OF DENTISTS U. S. A. SECTION

THE annual convocation of the U.S.A. Section of the International College of Dentists will be held at the Hotel Pennsylvania, New York, N. Y., December 3-4. The regents will meet at 10 a.m. and 2 p.m., December 3. The annual banquet will be held at 7 p.m., December 3. Headquarters will be maintained on the 17th floor through December 7. For further information and

hotel reservations, address

C. RAYMOND WELLS, *Chairman,*
Arrangement Committee,
Hotel Pennsylvania,
New York City.

PAN AMERICAN ODONTOLOGICAL ASSOCIATION

THE Pan American Odontological Association will hold its third annual dinner-meeting December 6 at 6:30 p.m. at the Hotel Pennsylvania, New York, N. Y. All members of the profession are invited.

RALPH HOWARD BRODSKY, *Exec. Secy.,*
205 W. Fifty-Seventh St.,
New York, N. Y.

HARVARD ODONTOLOGICAL SOCIETY OF NEW YORK

THE Harvard Odontological Society of New York will hold its third annual luncheon December 8 at 12 m., at the Hotel Pennsylvania, New York, N. Y.

LOUIS KROLL, *Secretary,*
515 Madison Ave.,
New York, N. Y.

ILLINOIS COLLEGE OF DENTISTRY ALUMNI HOMECOMING

THE Annual Alumni Homecoming of the University of Illinois College of Dentistry will be held December 6, all day, at the College, 808 South Wood Street, Chicago. At 6:30 p.m., a banquet will be held at the Lake Shore Athletic Club, Chicago.

M. K. HINE.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

A COMPETITIVE examination to select not more than twenty for appointment in the Dental Corps of the Navy will be held on January 9, at the Naval Medical School, Washington, D. C., Naval Training Station, Great Lakes, Ill., and Naval Training Station, San Diego, Calif. A candidate for appointment in the Dental Corps must be a citizen of the United States and must be between 21 and 32 years of age at the time of appointment, a graduate of a standard dental college, of good moral character and of unquestionable professional repute. Credentials relative to character, citizenship, date of birth and education must be submitted and approved before an applicant can be authorized to appear for examination.

A circular which contains full information relative to the Dental Corps and describes the method of making application for appointment can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS, REGULAR ARMY

AN examination for the selection of candidates for appointment in the Dental Corps, Regular Army, will be held February 12-17, 1940, including both physical and professional examinations. The latter, consisting of written, oral and clinical tests, is open to male citizens of the United States between the ages of 22-9/12 and 31-9/12 years at the time of the examination, who are graduates of acceptable dental schools and who have had at least 1-11/12 years subsequent practice in their profession.

Candidates who have failed in more than one previous examination for appointment in the Dental Corps, Regular Army, will not be permitted to undergo examination again.

Full information and application blanks will be furnished upon request to The Adjutant General, War Department, Washington, D. C. Applications will not be considered after January 27, 1940.

ALPHA OMEGA FRATERNITY

THE Alpha Omega Fraternity will hold its thirty-second annual convention in Newark, N. J., at the Essex House, December 30-January 1.

WILLIAM RICH, *Supreme Scribe,*
579 Belleville Ave.,
Belleville, N. J.

SOUTH DAKOTA STATE DENTAL SOCIETY

The fifty-eighth annual meeting of the South Dakota State Dental Society will be held at Sioux Falls May 12-13-14, at the Cataract Hotel.

ERNEST W. ELMEN, *Secretary.*

ALPHA OMEGA FRATERNITY DIRECTORY

THE Alpha Omega Fraternity is now in the process of publishing a new and complete directory of its entire membership. All fraters are hereby requested to forward their

names, office addresses, year and school of graduation to

WILLIAM RICH, *Supreme Scribe,*
575 Belleville Ave.,
Belleville, N. J.

DENTAL INTERNSHIPS

Applications for dental internships are now being received at Baltimore city hospitals. Applications should be in by February 1, 1940. Senior students interested may write for application blanks to the

Superintendent,
Baltimore City Hospitals,
4940 Eastern Ave.,
Baltimore, Md.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED AUGUST 15 AND DURING SEPTEMBER AND OCTOBER 1939

August 15

No. 2,169,817, to C. P. RUSSELL. Power operated amalgamator.

September 5

Re. 21,197, to WARREN E. HILL and CLIFFORD L. MCARTHUR. Toothbrush and process of making same.

No. 2,171,695, to ROBERT N. HARPER. Method and apparatus for procuring impressions of the surfaces of the anterior teeth for dental work.

No. 2,171,736, to CHARLES S. BALLARD. Art of making dentures.

No. 2,171,744, to CORNELL JOEL GROSSMAN. Cast metallic denture.

No. 2,171,759, to FREDERICK S. MEYER. Method of preparing dental restoratives.

No. 2,171,778, to GEORGE A. YANTIS. Mechanism for casting metals in investment material.

No. 2,172,063, to NOBUSHIRO HARA. Chair for use in medical treatment.

September 12

No. 2,172,478, to Bertram B. Machat. Tooth-extracting implement.

No. 2,172,528, to EDWARD S. AUER. X-ray marking device.

No. 2,172,591, to ARTHUR L. PETERSON. Dental floss holder.

No. 2,172,600, to FRED VAN DER WERTH. Toothbrush appliance.

No. 2,172,624, to GABRIEL ROMANI Y ROBERT. Toothbrush.

No. 2,172,743, to THOMAS IVAN TAYLOR. Composition of matter.

No. 2,172,998, to HOMER GROUT and ZACK LEMLEY. Gum massager.

No. D-116,622, to BERNARD JANKELSON. Design for a top for a dental cabinet or similar article.

September 19

No. 2,173,637, to FRANZ RIEDENER. Device for aseptic treatment of the root of a tooth.

September 26

No. D-116,838, to HENRY CAVE. Design for a toothbrush.

October 3

No. 2,174,523 to FRANK G. MANSON. Oxygen distributor.

No. 2,174,796, to AUGUST F. LUZZI. Semi-rigid gauze.

October 10

No. 2,175,278, to LOWELL H. OREBAUGH. Toothbrush.

No. 2,175,321, to JACOB A. SAFFIR. Dental amalgam mixer.

No. 2,175,365, to JACOB A. SAFFIR. Hypodermic syringe and cartridge and method of making cartridge.

No. 2,175,487, to AUGUSTUS GEORGE STALL. Toothbrush.

No. 2,175,782, to GERALD F. RORER. Anesthetic.

No. 2,175,952, to CHESTER R. BURNETT. Dental forceps.

No. 2,175,975, to LLOYD STEINER. Toothbrush.

No. D-117,123, to ALBERT FRANCIS LAYS. Design for an artificial tooth shade guide case.

October 17

No. 2,176,308, to ROBERT D. LARKIN. Sanitary tooth cleaning pad.

No. 2,176,309, to EDNA OPAL LOVE and EMMETT J. MOLITOR. Gum massager.

No. 2,176,339, to GUSTAVE J. HENNEMAN. Dental bur guard.

No. 2,176,575, to JAMES SORENSON. Dental device and method of utilizing same.

No. 2,176,620, to CALVIN MICHAUX BEAM. Dental illumination unit.

October 24

No. D-117,226, to CHARLES T. GERHART. Design for a liquid dentifrice dispensing bottle.

October 31

No. 2,178,043, to ARTHUR A. LAWRY. Dental pontics.

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Zinc Oxide-Eugenol Cements. Donald A. Wallace and Harold L. Hansen. (Council Dent. Ther.) 1536
Oxide-Eugenol Impression Paste, Securing Edentulous Impressions with. Vincent R. Trapozzano. 1527
Phosphate Cements, Certified (A. D. A. Specification). (Res. Com.) 1201

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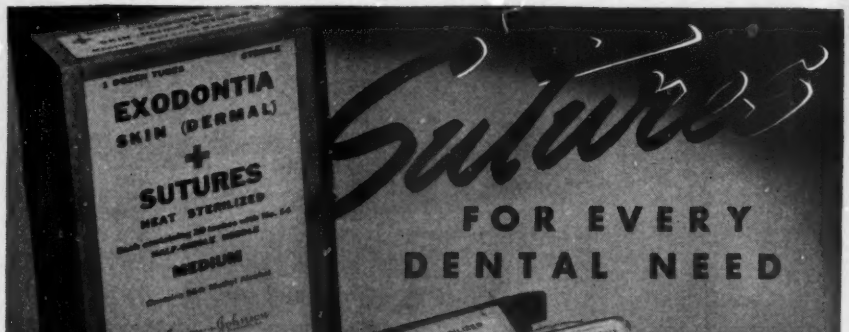

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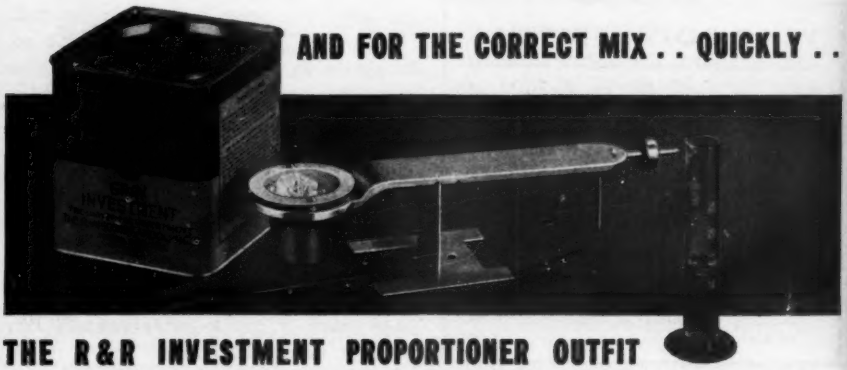

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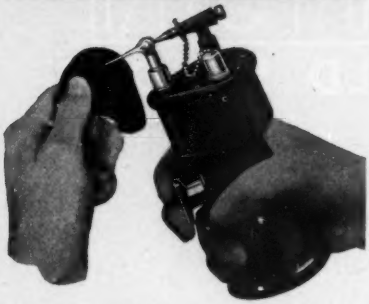

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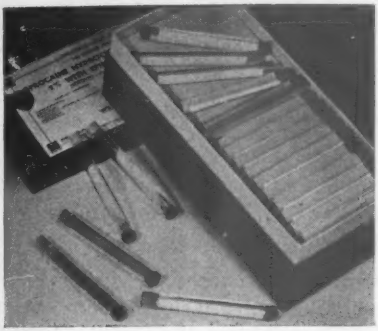

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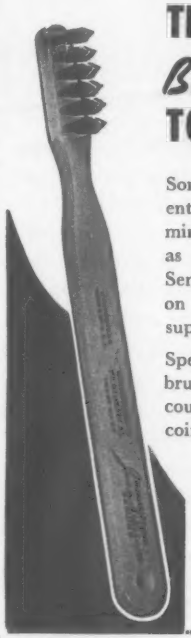

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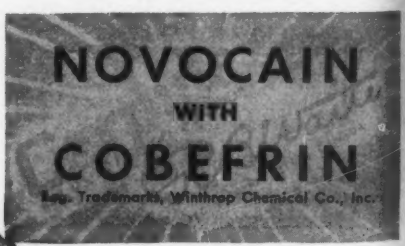

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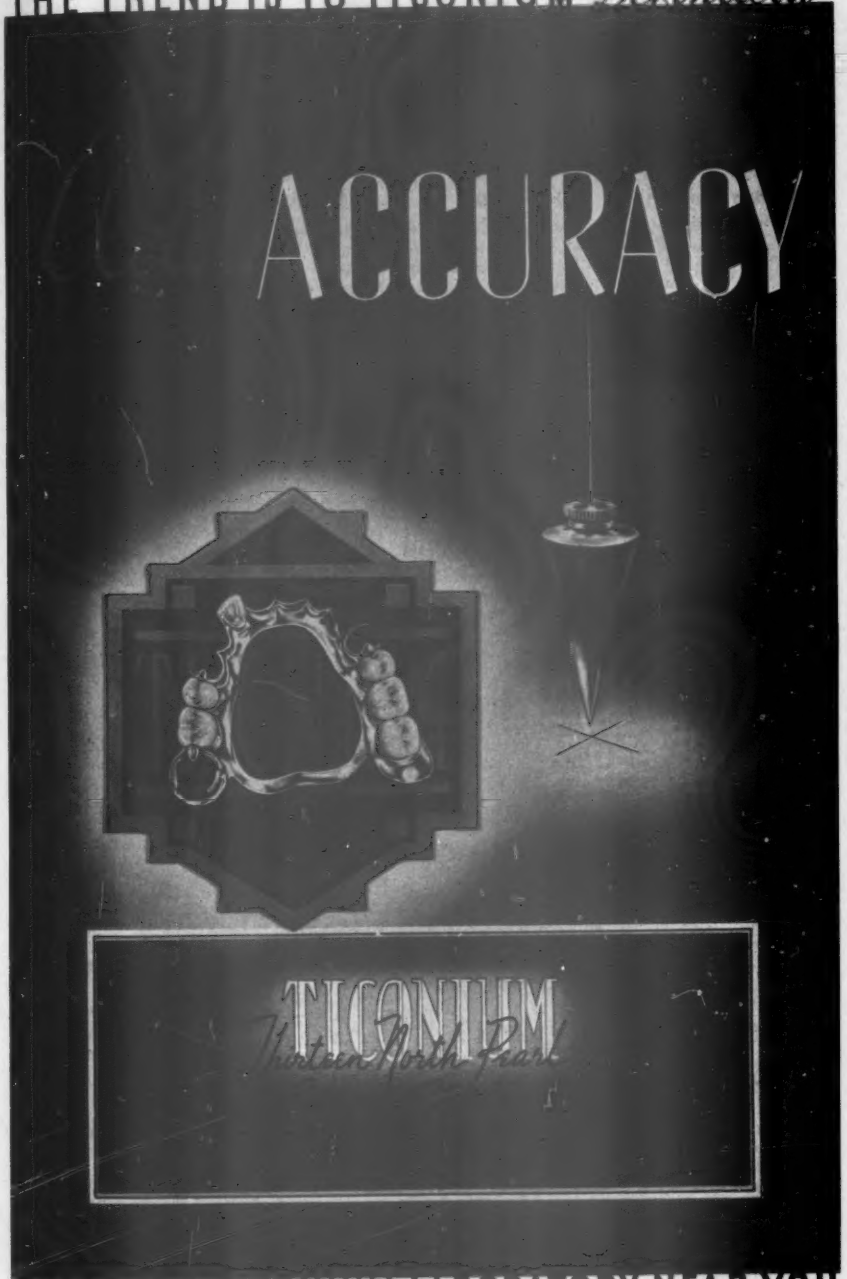

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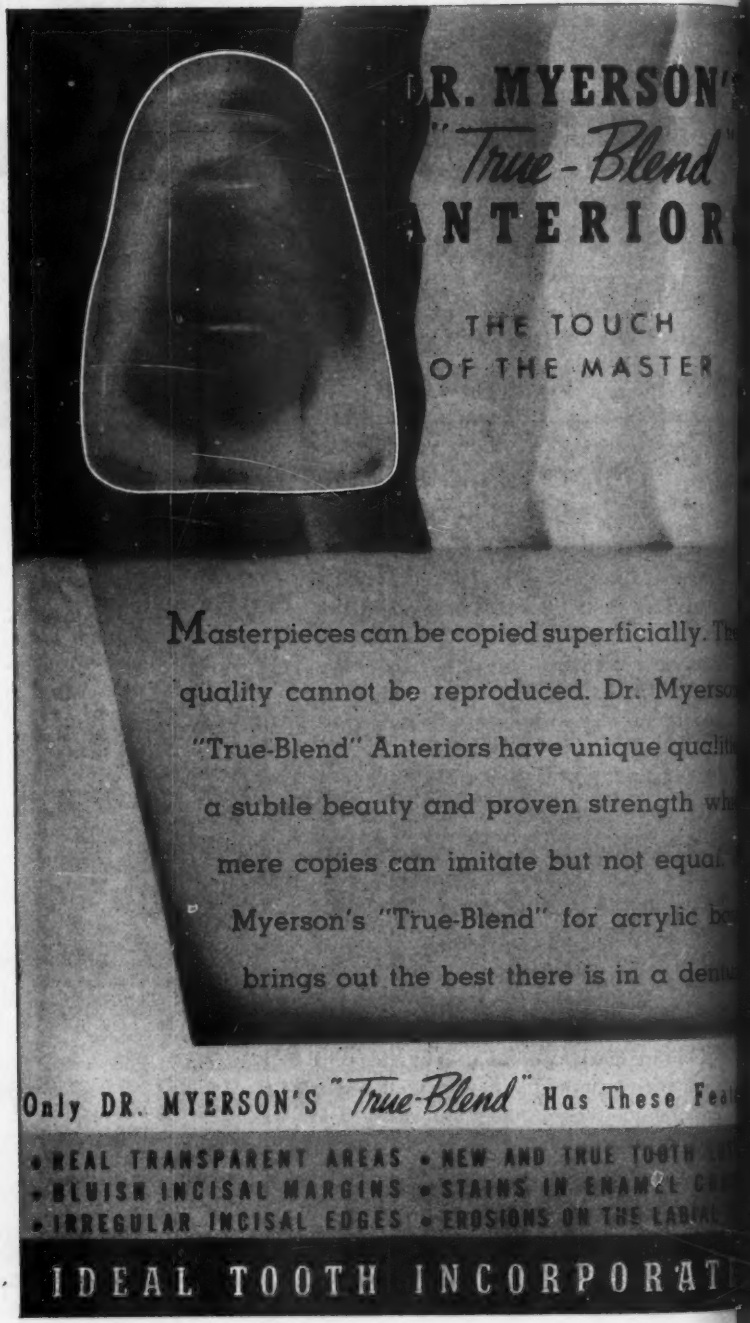
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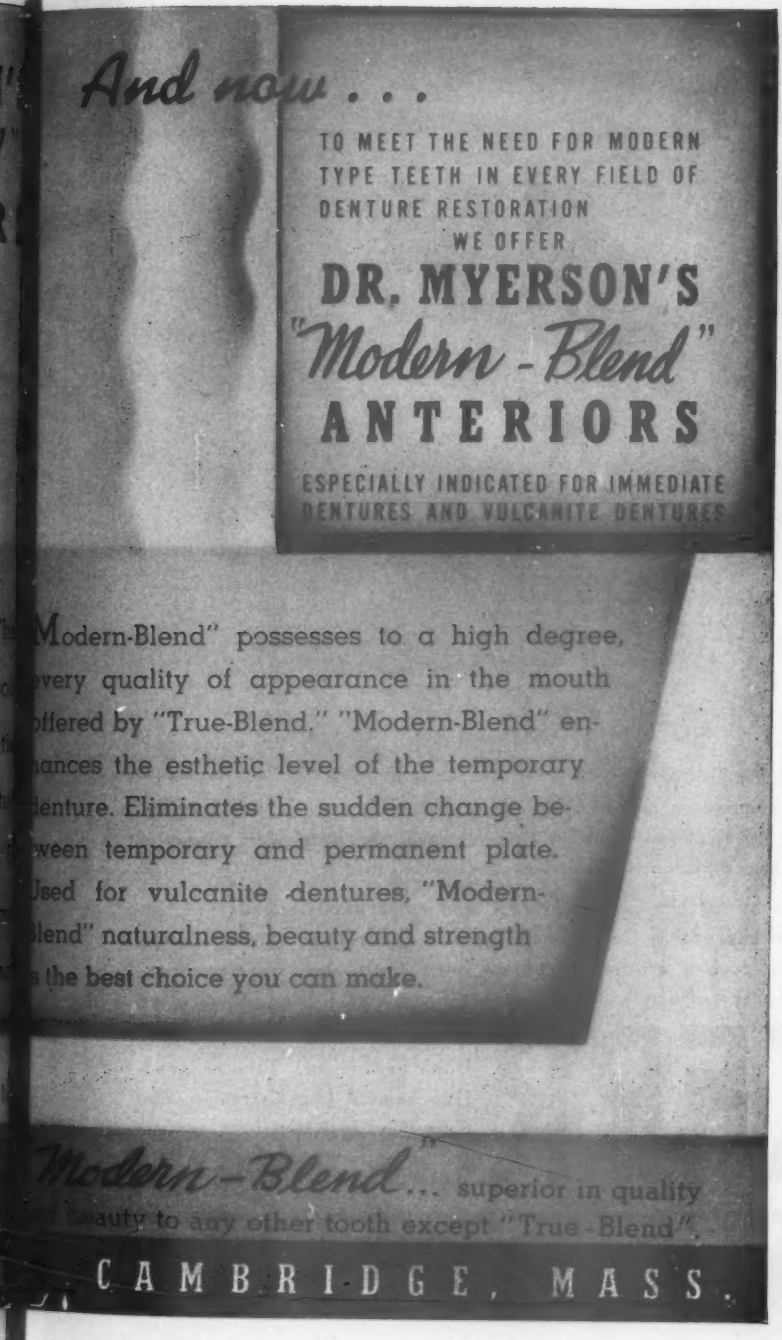
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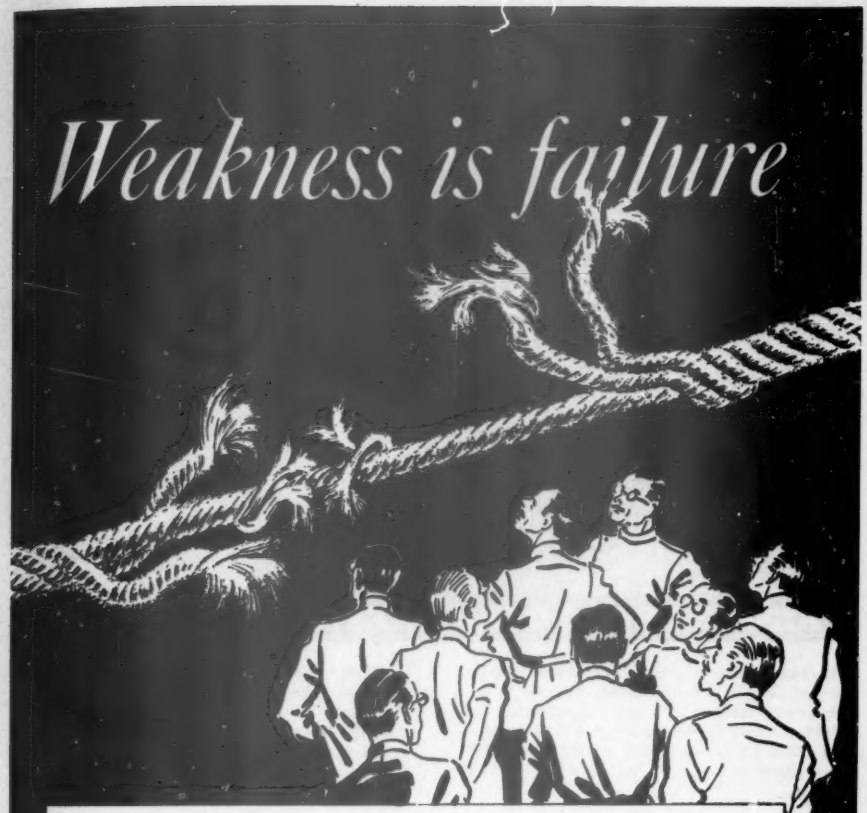

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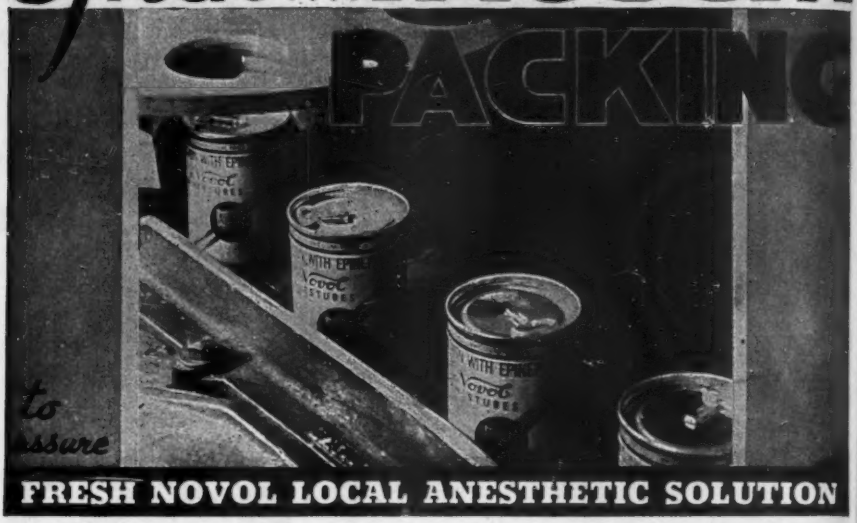

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METHODS FOR QUANTITATIVE ESTIMATION OF THE VITAMINS

III. Measurement of Vitamin A Activity

● It was early recognized that vitamin A deprivation in animals resulted in cessation of growth or—if long continued—in the appearance of a characteristic eye condition known as xerophthalmia (1). These two pathologic effects were both utilized in the first methods proposed for quantitative estimation of this essential food factor.

The earliest techniques for determination of vitamin A were similar in that they all first provided for depletion of the body stores of vitamin A of the rat by restriction of the animals to basal rations free from or quite deficient in the vitamin. In the "rat growth" method, the vitamin A activity of the material under assay was estimated by feeding graded dosages to animals depleted of the vitamin (as gauged by cessation of growth) and recording the ensuing growth response (2). In the "curative technique," the incidence of xerophthalmia served as the criterion of vitamin A depletion (3), and vitamin A activity was estimated by determining the dosage of the test material necessary to establish cure of xerophthalmia.

Techniques were also gradually developed which in some instances embodied features of both the growth and curative methods. Still another technique based on the continuous appearance of cornified epithelial cells in vaginal smears—a further characteristic of vitamin A deficiency in female rats—was evolved (4). Further research showed that colorimetric and spectrographic methods may be adapted to the estimation of vitamin A activities of specific materials (5).

Of all methods for estimation of vitamin A in foods, the rat growth technique appears to be favored today (6). Gradual improvements and refinements—as well as recognition of the existence of provitamins A—have led to development of the growth method now included in the U. S. Pharmacopeia XI. This method requires that young rats weighing 40 to 50 grams (at an age not exceeding 28 days when placed on a vitamin A deficient ration) shall manifest symptoms characteristic of vitamin A deficiency within a period of 25 to 45 days. Rats properly depleted of vitamin A reserve are assembled in negative control groups receiving no supplement, reference groups receiving graded doses of the standard reference material, and assay groups receiving graded doses of the assay material. During the ensuing period of not less than 28 days, the test animals are fed daily doses of the proper supplements. The body weights of the animals are recorded at frequent intervals during and at the end of the assay period. From the average gains in body weight of rats in the assay and reference groups, dosages of assay and reference materials, and the vitamin A activity of the standard of reference, the vitamin A activity of the assay material is calculated.

Many researches (7) have established that commercial canning procedures are without significant effect upon either the provitamins A or vitamin A in foods. Consequently, the canned varieties of foods noted for their vitamin A activities provide valuable, convenient and economical sources of this dietary essential.

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(1) 1913. J. Biol. Chem. 16, 423 and 255.
(2) 1928. J. Biol. Chem. 78, 671.
(3) 1931. J. Dairy Sci. 14, 229.
(4) 1927. J. Biol. Chem. 73, 153.
(5) 1938. J. Am. Med. Assoc. 111, 245.
(6) 1936. The Pharmacopeia of the United States, Eleventh Decennial Revision, page 478.
(7) 1929. Ind. Eng. Chem. 21, 347.
1936. J. Am. Diet. Assoc. 12, 231.
1936. Mass. Agr. Expt. Sta. Bull. No. 338.
1938. Nutrition Abstracts and Reviews, 8, 281.

We want to make this series valuable to you, so we ask your help. Will you tell us on a post card addressed to the American Can Company, New York, N. Y., what phases of canned foods knowledge are of greatest interest to you? Your suggestions will determine the subject matter of future articles. This is the fifty-fourth in a series, which summarize, for your convenience, the conclusions about canned foods reached by authorities in nutritional research.

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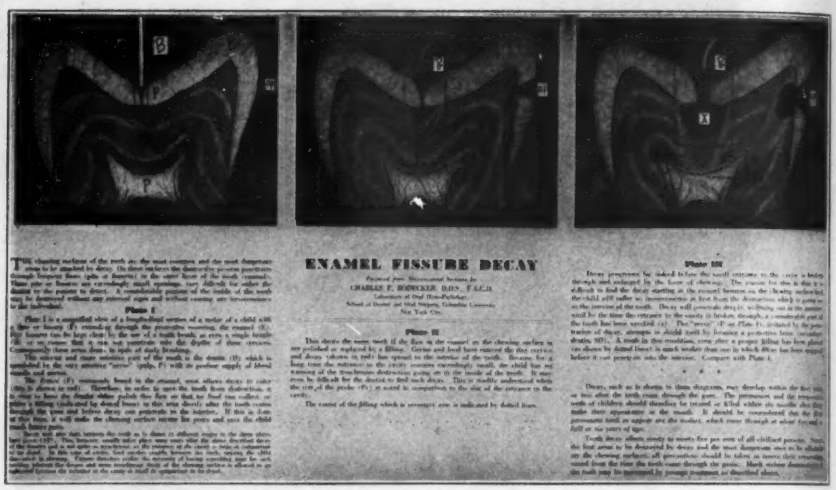

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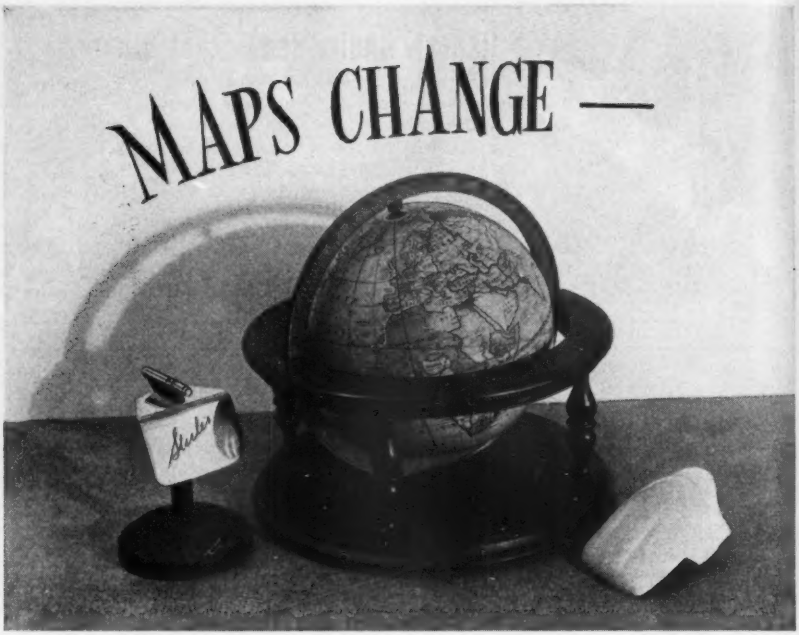

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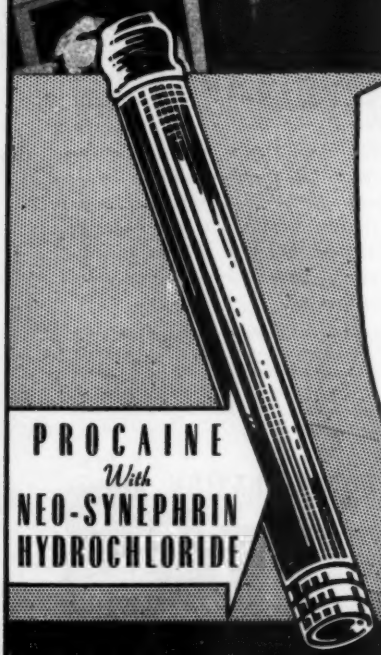

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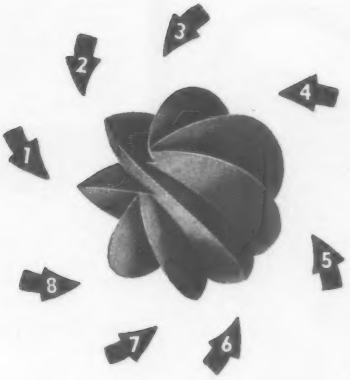

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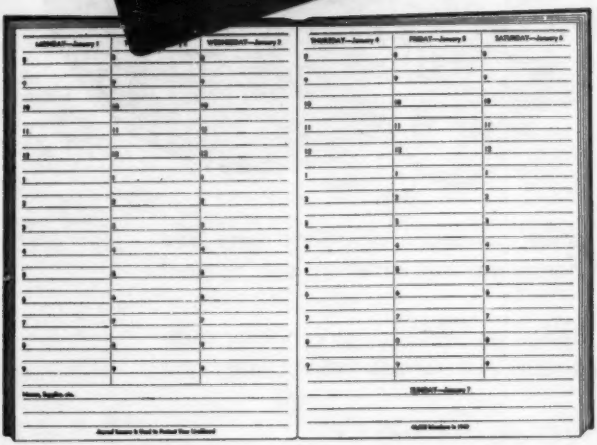

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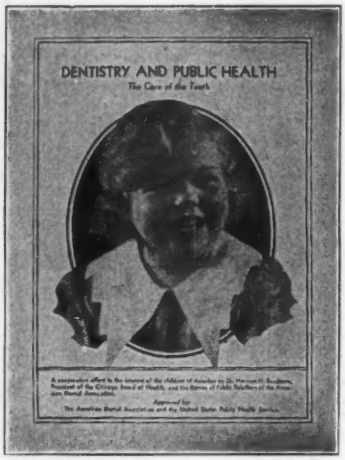

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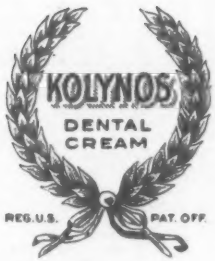

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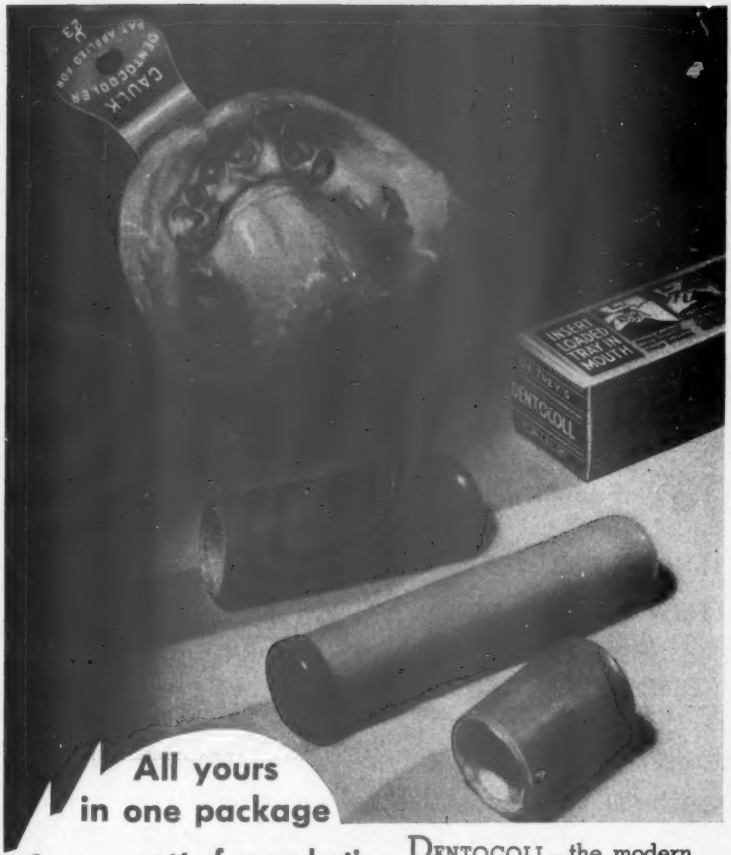

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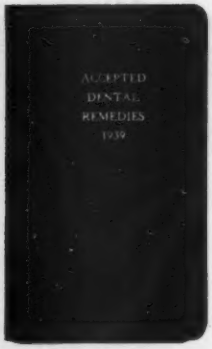

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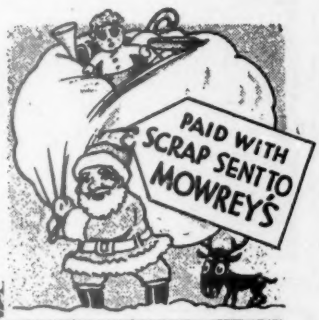

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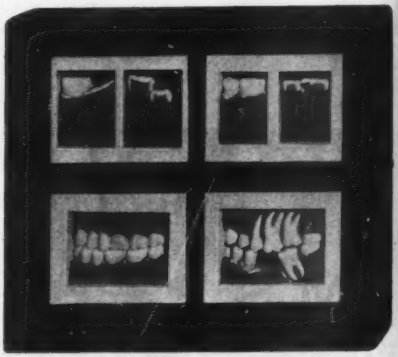

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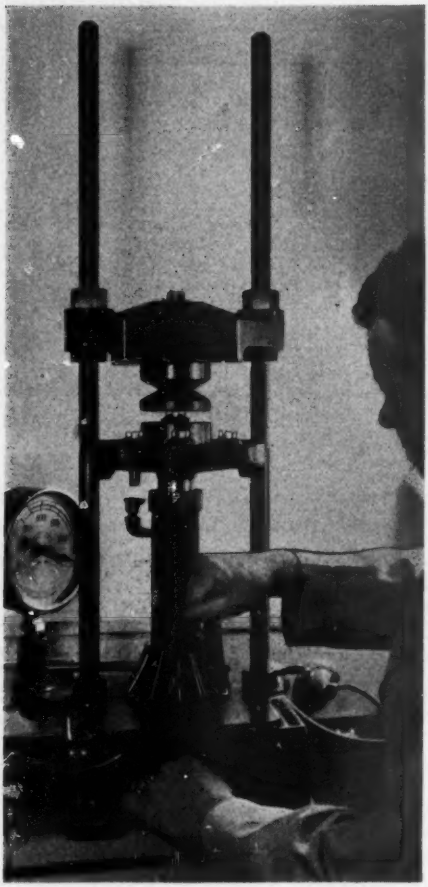

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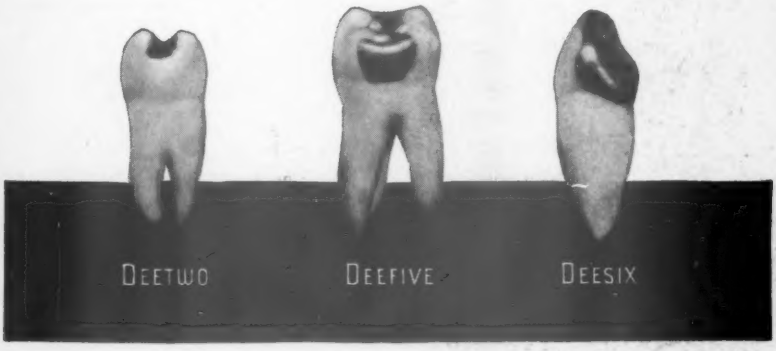

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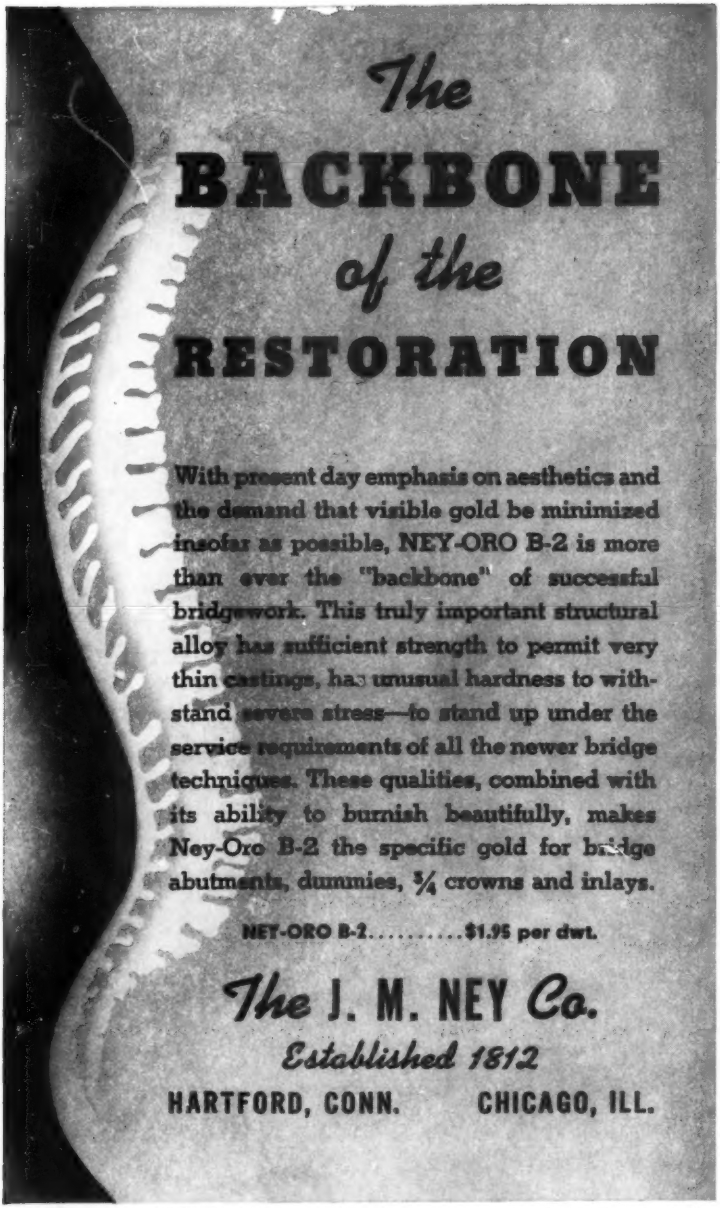
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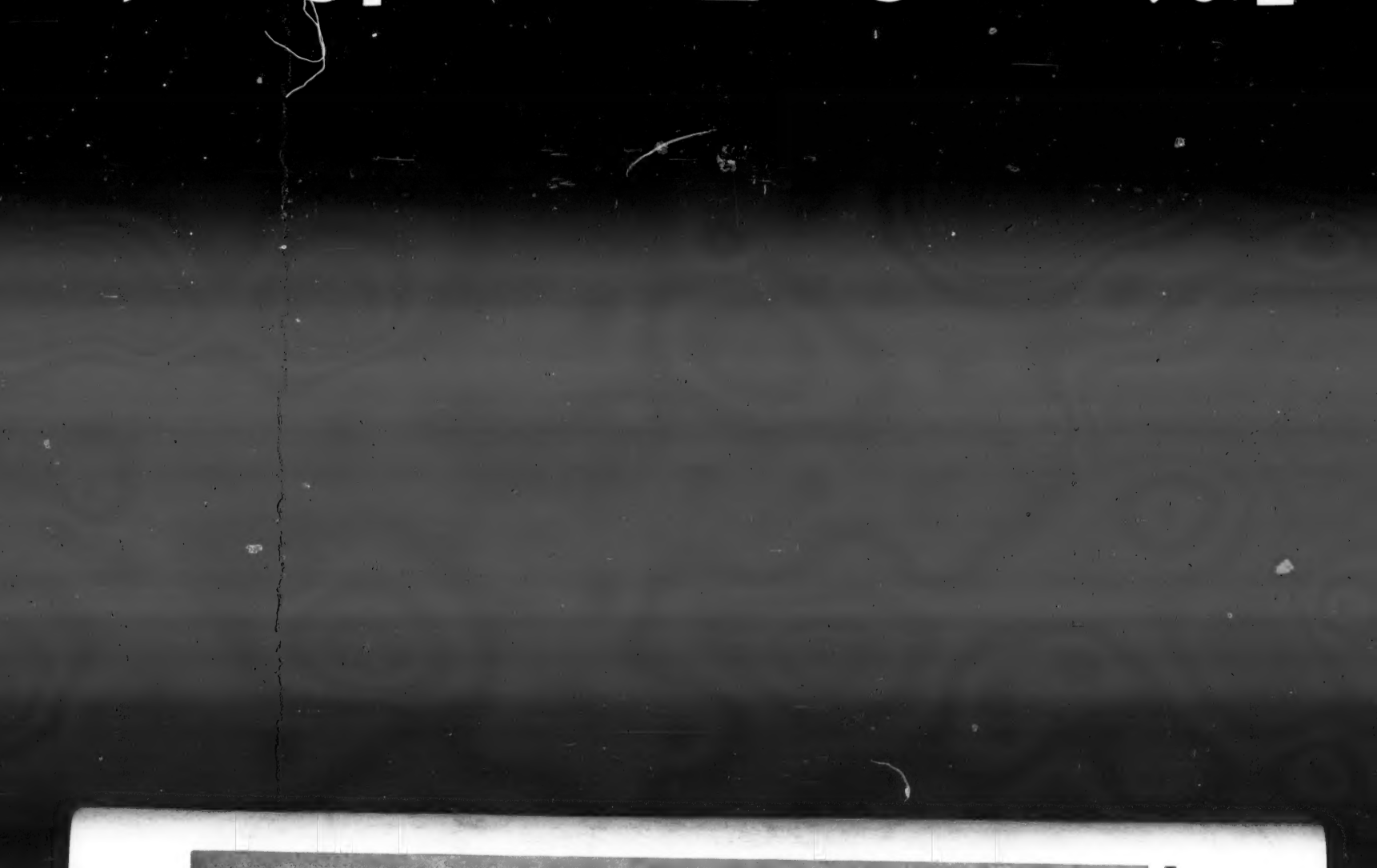
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